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ORIGINAL ARTICLES.

THE GREAT PYRAMID AND ITS SYMBOLISMS.

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The Pyramids, on account of their huge proportions and great age, have long been classed among the seven wonders of the world.

To obtain some idea of the Great Pyramid of Egypt, let us imagine a vast space, covered over with huge blocks of rock brought from the mountains across the valley of the Nile, over a causeway prepared for the purpose, which preparatory work, according to Herodotus, took 100,000 men ten years to accomplish.

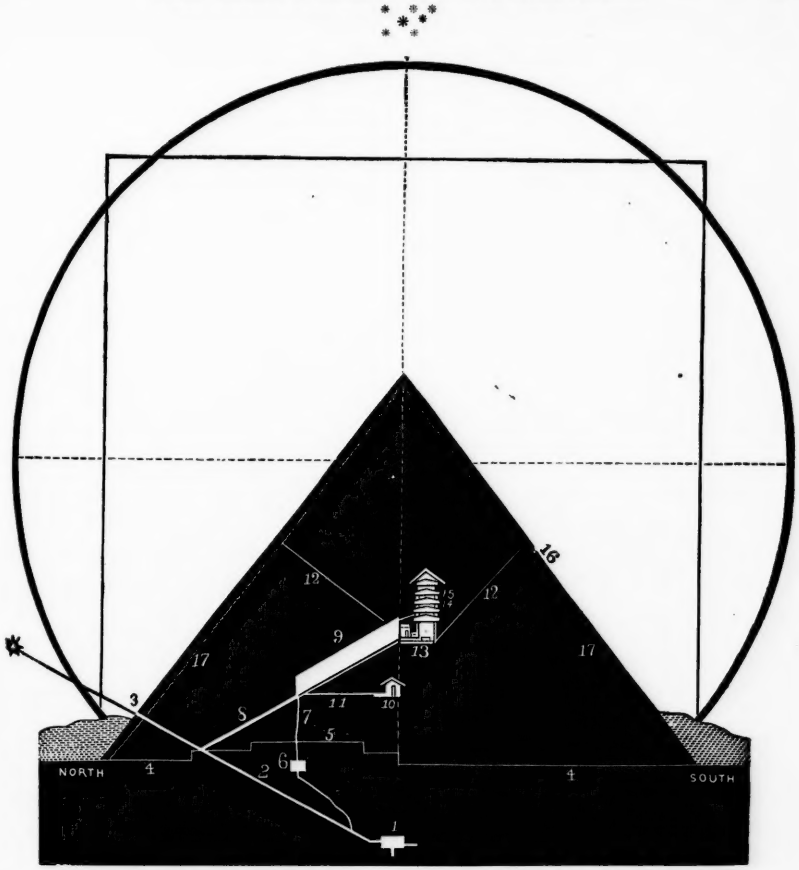
This army of laborers lay off a thirteen acre field, and begin to arrange the rocks in rows, not only all around it, but all over it, filling in all crevices till it is one solid mass. Then they pile a second layer over the first, and a third over the second, and so on till they get as high as the tall forest trees, say eighty feet in height. Then they build on till they reach double that height, one hundred and sixty feet; then till they treble it, two hundred and forty feet; then till they quadruple it, three hundred and twenty feet. They continue to ascend, day by day, week by week, month by month and year by year till they rise higher by far than the tallest steeple in the world, till they reach a height more than a third as high as a forty acre field would be if turned up edgewise. The base of this

immense structure is more than half a mile around, and when a man stands on the top he cannot throw a stone half way to the outside of the base. This faint description may convey some idea of the hugeness of this structure, and what gave it the rightful claim to be classed first among the seven wonders of the world. There it stands to-day as it stood before the days of Moses or Abraham, older than history either profane or sacred, over four thousand years old, the oldest, the tallest, the most solid and substantial building on the earth.

We shall be excused if we stand awhile and tarry and gaze at this wonder, and take time to grapple with the questions *When*, and *How*, and *Why* was this structure erected. If the statements published to the world are to be credited there are newly discovered wonders in that artificial "Rocky Mountain," by the side of which what we have been considering shrink into almost inconceivable littleness. I refer particularly to the discoveries of Prof. Piazzi Smyth, Astronomer Royal for Scotland, Sir John Herschel, Col. Howard Vyce, John Taylor, Wm. Petrea, and others. I am aware that some of the theories and claims of these men are regarded as more chimerical than substantial. Nor do I wonder that scientists, confirmed in preconceived notions which are adverse to these discoveries, should, upon their first announcement, regard them as sheer nonsense, the fancies of a one-idea brain, and that in their offended prejudices against what at first sight appears absolutely absurd they should turn from the subject with disgust as absolutely unworthy the attention of scholars. But admit the facts which we propose in this paper to demonstrate, and with Prof. Smyth they must acknowledge that "the Great Pyramid is the highest and holiest subject that can ever occupy the attention of a scientific society," The new American Cyclopædia (a standard authority and a library in itself) in its article on this subject notices Prof. Smyth's theory and his claims, (that astronomical problems and metrical systems are memorialized in the Great Pyramid). But it disposes of these claims very summarily by declaring that they were not supported by hieroglyphic inscriptions, nor the testimony of the ancients. Of course they were not. This is a most important admission. But is it scholarly to discard facts because of recent discovery? I shall now treat the problems in this venerable structure with such figures and forms of expression as seem most adapted to convince, not in the order of their discovery or importance, but in the way most likely to attract attention, till the beholders are anchored in its intricacies and compelled to consider its tremendous facts.

PROBLEM I. *The perimeter of the Pyramid equals the periphery of a circle whose radius is the vertical height of the Pyramid.* (For illustration see figure.)

Now if we take a point directly under the apex of the Pyramid, at its square base, and describe a circle with the height of the Pyramid as our radius, we do precisely the reverse but the full equivalent of squaring the circle. The height of the Pyramid is 5813 inches; the length of one side is 9131 inches. To obtain the perimeter of the Pyramid we multiply the length of one side by four, its number of sides. To obtain the periphery of the circle we double the radius and



PYR-MET or PYRAMID.

1. Lower chamber. 2 Descending passage 3. Entrance. 4. Natural rock platform. 5. Natural rock elevation. 6. Cavern. 7. Well hole. 8. Ascending passage. 9. Great Gallery. 10. Queen's Chamber. 11. Passage from the Great Gallery to Queen's Chamber. 12. Passage for ventilation. 13. King's Chamber. 14,15. Small apartments above King's Chamber. 16. Outer surface with casing. 17. Outer surface with casing removed.

multiply it by the figures designated by mathematicians as *pi*, Greek p, viz: 3.14159, and we have thus, 9131x4=36524; 5813x2=11626x3.14159=36524.-12534. Admit the possibility of a human error in the measurement of the Pyramid of less than one-tenth of an inch on each side, and we have precision which is as near perfection as human skill ever approaches.

I digress here for a moment, simply to call attention, as we pass on, to these figures 36524.12534. Mark how suggestive they are on the circle of the number of diurnal revolutions of the earth, or days, during one annual revolution, or year, with precisely one hundred inches to a day, exhibiting at a glance a ten-division system for the measure of time. (See figure.) The problem just illus-

trated involving the squaring of the circle, was discovered by a man who had never seen the Pyramid himself, but only charts of it. He saw in the slope of the Pyramid a very peculiar and intricate angle to work by, viz: 51° 51′ 14.3″. He used this angle in connection with a base side to calculate the height, and saw that the most minute variation of this angle would augment or diminish the height. This led to the inquiry, why was it built just so high when it required such an inconvenient angle to work by, unless it was necessary to accomplish a certain design? The peculiar proportions soon suggested the answer to the inquiry.

The Greek philosopher who ran through the city crying *Eureka!* on the solving of his intricate problem, was not more overwhelmed with emotion than was John Taylor when he found *pi* or the modern method of squaring the circle in the Great Pyramid. He published his discovery, and men of brains marveled, and still they marvel. And well they may, for the solution of this problem involves others more intricate and more marvelous. The *pi* is found here by the rule of proportion thus: As the height is to half the perimeter, so is 1 to *pi*, 5813: 18262.1 : : 1 : 3.14159. It is so simple when we see it that we do not wonder that John Taylor found it there. But the wonder is, *who had the genius to put it there?* It was there by accident or design. No scholar regards it as an accident. *Pi* reveals as much design as a watch does, and it would not be as reasonable to regard a watch as a creature of accident as *pi*. But for what was it designed? Certainly not for the benefit of the people then living, for it is admitted that it was not then discovered. (See American Cyclopædia, article Pyramids). Prof. Piazzi Smyth, and some others, give us their answer to this question. We wait for scientists to give us a more consistent one if they can.

PROBLEM II. *The distance of the sun from the earth, divided by twice the Pyramid's height equals the earth's polar diameter.*

This I have evolved out of a problem discovered by Wm. Petrea, civil engineer. I state this in this form to exhibit at first view the correlations of the sun, the earth and the Pyramid to each other. Now the earth's polar diameter, according to our late school books, is 7899 even miles without counting the fraction. But the Pyramid had it 7899.56 miles over four thousand years ago by dividing the sun's distance, 91,840,270 miles, by twice the Pyramid's height, 11,626. 91,840,270÷11,626=7,899.56. This is precise enough. But where in the Pyramid do we obtain the 91,840,270 miles as the sun's mean distance from the earth? We will explain. The vertical height of the Pyramid, multiplied by the number which its peculiar geometrical shape symbolizes, *i. e.* ten raised to the ninth power (1,000,000,000), equals the sun's distance from the earth. Now any number divided by *twice* the height, equals *half* that number divided by *once* the height. This is equivalent to 45,930,135÷5813=7899.56, as before. The Pyramid's shape is such that beginning at the apex and measuring downward, for every ten feet of perpendicular descent it expands nine feet horizontally. Hence the claim that it symbolizes ten raised to the ninth power as one of the factors in calculating the

sun's distance. The height of the Pyramid is 5,819 English inches, which multiplied by 1,000,000,000, (ten raised to the ninth power), equals 5,819,000,000 inches, or 91,840,270 miles for the sun's mean distance from the earth. The ancients estimated the distance of the sun from the earth at 10 miles; it was increased afterward to 10,000 miles; then it ran up to 2,500,000 miles; it then took another leap to 36,000,000 miles; again it was estimated at 75,000,000 miles; early in this century it reached 95,000,000 miles; then it decreased to 91,500,000 miles; again it increased to 92,500,000 miles; now it is estimated at 91,840,000 miles. This last estimate is that of M. Puiseux, a French astronomer, made since the last transit of Venus, when the solar parallax calculated from observations in China and the Indian ocean, was determined at 8,879 seconds of a degree. M. Puiseux thinks it improbable that there can be an error in his calculations which will reach the second fractional figure, (7). This calculation must therefore approximate exactness. Present astronomical science, under the most advantageous circumstances, by the aid of the most exquisitely wrought and improved astronomical and mathematical instruments, including telescopes, azimuth compasses, equatorials, transit instruments, regulator clocks, etc., together with the aid of the present day astronomical knowledge of the Universities of the world, in round numbers, without presuming to run down to the preciseness of hundreds and tens, in numbers of such great magnitude, says that the sun's distance from the earth is 91,840,000 miles. And the Pyramid said it was 91,840,270 miles, without any of these aids in calculating and before any of them were invented. A French paper, the *Les Mondes*, on the announcement of M. Puiseux' estimate, exclaims, "*La Grande Pyramide a vaincu.*" The Great Pyramid has conquered. I confess to a shock coming over me like that occasioned by a clap of thunder when I made and compared these estimates, and saw an exactness which suggests superhuman knowledge in the architect of the Great Pyramid, and in its correlations, not only to the earth, but to the solar system, and extending even to the system around which ours revolves.

Prof. Piazzi Smyth's theory is that the Great Pyramid was planned by inspiration, as was the case with the ark, the tabernacle and the temple; and that it bears a relation to science similar to that of the Bible to Christianity, and that it was designed as a symbolism of geographical and astronomical correlations to our earth, so accurate as to demonstrate a harmony between science and religion in our day when such a demonstration is very desirable. We know that man's works never attain perfection at once, that always and everywhere there is a gradual advance from the crude to the more accurate and beautiful, and that better styles of architecture are preceded by those less advanced. But in the Great Pyramid all of these laws are reversed, and the best is presented first. For no other pyramid has any of these symbolisms, although they were evidently constructed after this pattern so far as the builders understood it and were able to imitate it. It is a sudden presentation of perfection in scientific knowledge in advance of *means* for obtaining it, monumentally commemorated. Egypt had no *scholars* then nor afterward. Renan says that "not a reformer nor a great

poet, not a great artist, not a savant, not a philosopher is to be met with in all their history." Brugsch says that what astronomical knowledge the Egyptians had "was based on empiricism and not on that mathematical science which calculates the movements of the stars." There is nothing that even suggests the *evolution* theory in the Great Pyramid. Osborn says, "It bursts upon us in the flower of its highest perfection." Dr. Seiss says, "It suddenly takes its place in the world in all its matchless magnificence, and as clear apart from all evolution as if it had dropped down from the unknown heavens." Renan says, "It has no archaic epoch." Now how shall we account for all this? Those who are living in the past, who think it unreasonable to overturn old theories with new facts, may be satisfied with dismissing at once what was not supported by the ancients. Those who are too timid to grapple with difficulties, may be satisfied with looking them squarely in the face and then passing on, as a certain preacher managed hard texts of scripture. And ridicule may suit the superficial and thoughtless. But practical, persistent, logical thinkers require an intelligent answer. Prof. Smyth accounts for it on the inspiration theory. This is one solution of the difficulty. If scientists have any better solution let them advance it Many people are holding their judgments in abeyance, waiting for a sensible reply.

PROBLEM III. *The Pyramid symbolises a cycle of our solar system around a very remote centre.*

This it does by its star pointings and was discovered before the problems already demonstrated. Sir John Herschel, who was ever on the alert to rival as an astronomer, his distinguished father, (the discoverer of Uranus and the nebulous theory) noticed the peculiar entrance to the Pyramid, fifty feet up, so high from its base as to make it extremely difficult to enter, and he wrestled with the query, why such a peculiar entrance? His cultivated genius soon discovered that the angle of declination in that entrance was precisely that of the earth on its polar axis, and that about the time the Pyramid was supposed to have been built, there was a very peculiar stellar combination He learned very soon, by astronomical calculations, that the North star of that period, called Draconis, pointed exactly down that entrance, while on the meridian of its extremely small axis, precisely at the time when the Pyramid, with its sharp pointed apex, was pointing to the star Alcyone, the principal and centre star of Pleiades, known among the common people as the seven stars. This very peculiar and exceedingly interesting combination of star correlations too marked the beginning of a cycle, which will end with a complete revolution of our solar system around the Pleiades in 25,868 years from that time. Herschel concluded from the close proximity in time of this remarkable stellar combination to the time when the Pyramid was built, according to the most authentic testimony, and from the seeming fitness in having such an event memorialized, that it was finished on that occasion. Recently discovered chronological marks in that entrance passage way of the Pyramid are said to corroborate the conclusion of this distinguished astronomer on that point.

There is another very singular coincidence worthy of notice in these cele-

brated star pointings. The star Draconis, which points down that dreary, slippery, obscure passage, which extends far below the foundation of the structure into the "blackness of darkness forever" where no sunlight ever reaches, signifies Dragon, while Alcyone, the star toward which the apex (the *chief* corner stone and *head* stone of the corner) points, on which the sun shines on all sides at once, is in Greek, Halcyon, signifying peaceful, happy. When we reach the discussion on the harmony between revelation and science we may have occasion to refer to what infidels call Bible contradictions on astronomical subjects. For example, in the oldest book of the Bible, Job states an unvarnished scientific fact when he says, "God hangeth the world upon nothing." (Job 26, 7). But God speaks to Job about laying the foundations and measures, and stretching a line upon it, and at last clapping on a corner stone, on which occasion the morning stars sung and the sons of God shouted. He tells him also of the "sweet influence of Pleiades." Now whoever cannot reconcile this highly figurative declaration to such a symbolism of the earth as then stood in all its primeval comeliness without doing violence to the same fact stated scientifically by Job himself, has not sufficient capacity to appreciate either sublimity in eloquence or beauty in poetry.

The American Cyclopædia in its article on astronomy says, "We may accept Prof. Smyth's conclusion that the building of the Pyramid corresponded to the time when the star Draconis, at its upper transit, was visible, (as well by day as by night) through the long inclined passage which forms one of the characteristic features of the Pyramid. This would set the epoch about the year B. C. 2170. And it is a remarkable fact, that as Prof. Smyth points out, the Pleiades were at that time in a most peculiar position, well worthy of being monumentally commemorated, for they were actually at the commencing point of all right ascensions, or at the very beginning of running that great round of stellar chronological mensuration which takes 25,868 years to return into itself again, and has been called elsewhere for reasons derived from far other studies than anything hitherto connected with the Pyramid, *the great years of the Pleiades*" This article adds, "But although we may thus set the astronomical system of the Egyptians in a far antiquity, it seems unsafe to follow Smyth in believing that the builders of the Great Pyramid were acquainted with the sun's distance, with the true length of the processional period, and with other astronomical elements, the discovery of which has rewarded the exact methods and the profound mathematical researches of modern times." I would ask then the stunning question of a modern genius, What are you going to do about it? What theory have scientists to advance which will harmonize their own admissions? The inspiration theory does not involve the difficulty that the Egyptians knew, what *we now* know about astronomy. Was it necessary in the erection of the temple that the builders should have understood the design of the architect? The inference that a building erected implies on the part of the workman a knowledge of the design of the architect, whether inspired or uninspired, is not warranted by the logic of facts, nor the logic of reason.

PROBLEM IV. *The Pyramid presents a symbolical ten-division metrical system.*

To this department of the Pyramid's symbolism we cannot present a parallel offered by science. Man's inventive genius has not produced a system of measures that for convenience or correctness will compare with it. The bungling, inconvenient systems now in use are as far behind the Pyramid system as the old way of numbering by letters was behind the present method of numbering by figures. The French government has adopted a ten-division metrical system with a unit of linear measure called a meter. This meter is obtained by dividing the distance in inches from the equator to either pole of the earth into 10,000,000 equal parts, and taking one of these divisions or meters as the most convenient measuring rod, corresponding somewhat to our yard stick. This unit is an odd number and a fraction reduced to decimals extended to five decimal figures, "and still there's more to follow," viz: 39.37079 inches to represent a unit or one. It is admitted that by geodetic measurements, up to 1875, this unit or one falls short of its definition by $\frac{1}{5400}$ part; so that it lacks by so much the merit of being correct. (See American Cyclopædia). They take the exact $\frac{1}{10000000}$ of an erroneous number in order to obtain such an awkward indivisible number as 39, with five decimal figures 37079, as a caudal appendage, curtailed at that, from the standard unit of one of linear measurement. And that is the triumphant attainment of *science* in this direction! Like other fashions of similar origin, other nations are adopting it, and some scientists are recommending it for *universal* adoption. Merciful Heaven! Deliver us! Another system, much more simple, has recently been presented for the consideration of the Congress of the United States by Hon. Alexander H. Stevens, of Georgia. Its linear table reads thus:

100 hairs = a nail.
100 nails = a meter.
1000 meters = a kilo.

This lacks the important qualification of definiteness in its unit, which is just about as precise as a piece of chalk. Now the Pyramid presents us with a measuring rule without any of the above named defects. Its length is twenty-five Pyramid inches, or 25.025 English inches, numbers easily adjusted to each other. This twenty-five inch rule has the merit of being the *true* $\frac{1}{10000000}$ of the distance from the centre of the earth to either pole. This, therefore, is in exact proportion to the polar diameter that the French meter *pretends* to be to the earth's polar circumference, with the additional advantage of a straight line through the earth, instead of a crooked one around it, as its standard of straight linear measurement. The distance from the centre of the earth to either pole, as we have shown, is 250,000,000 Pyramid inches, or 250,250,000 English inches, which divided into 10,000,000 equal parts make as its unit of measure 25 Pyramid inches or 25.025 English inches. The inch of the Pyramid is about half the width of a fine hair longer than the English inch. It requires no great stretch of credulity to believe that the Pyramid inch was the measure from which our English inch originated. The marvel is that after the wear incident to the changes of more than four thousand years the difference now should be no greater. The French table of linear measure is founded thus:

39.37079 inches = 1 meter.
10 meters (363.7079) = 1 decameter.
10 decameters (3637.079) = 1 hectameter.
10 hectometers (36370.79) = 1 kilometer.
10 kilometers (363707.9) = 1 myriameter.
$\frac{1}{10}$ = a decameter.
$\frac{1}{100}$ = a centimeter.
$\frac{1}{1000}$ = a millimeter.

Now by the side of this monstrous jaw-breaking combination of terms, incapable of being understood except by classical scholars, and incorrect besides, let us place a table of linear measurement which we will draw out of the Pyramid. The name Pyramid, like other oriental names of olden times, had a signification. According to the opinion of Chevalier Bunsen, an oriental scholar and one of Prussia's ablest scientists, *pyr* in the old Coptic language signified division. The *peres* in Dan. 5:28, was from the same root. And *met* signified ten. By combining these words we have *pyr–met*, which signifies ten divisions, and which comes nearer the present day spelling and pronunciation of pyramid than many English words now do to their originals. So pyr–met, or pyramid, symbolises in its name its own ten-division metrical system. In the carefully marked measures of the interior of the Pyramid the shortest linear measure is one-tenth of an inch. As pyr means division, this is the pyr or division of an inch, and it takes ten of them to make an inch. This gives us a start. We will proceed and see what we get, thus:

10 pyrs = 1 inch.
10 inches = 1 met = 10 inches.
25 inches or 2½ mets = 1 cubit = 25 inches.
10 mets or 4 cubits = 1 meter = 100 inches.

Sir Isaac Newton said that the cubit that Moses and Solomon used, called the sacred cubit, was about twenty-five inches. The cubit of the Pyramid is the same. It is about the length of a carpenter's rule or iron square, while the meter would be near the length of an eight foot pole, both very convenient measuring rods. We would need to add something to correspond as a ten-division number to one mile perhaps, thus:

1000 cubits = 1 cubit mile, or
1000 meters = 1 mille,

and we have a table not only wonderfully adapted to the round ten-division numbers of the geographical and astronomical measurements to which we have referred, but a table so simple that a child who could count a hundred would understand it, and it would be amply sufficient for all the computations by logarithms or otherwise, of the most profound mathematicians. The 2½ mets to a cubit is the equivalent in linear measure to the 2½ dimes to a quarter of a dollar in our money measure; and one is about as indispensable for convenience as the other.

Sir John Herschel has advocated very strongly the metrical system which he

saw in the Pyramid as immensely superior to the French system now so widely used. Pres. Bernard says if the French metrical system had to be created anew, its promoters would profit by what is now known. A French mathematician, M. Callet, as early as 1795, long before the discovery of this peculiar cubit of twenty-five pyramid inches, recommended the adoption of exactly twice this length as a suitable unit of measure. In his book on logarithms he suggested the even $\frac{1}{10000000}$ of the earth's polar diameter as the standard with which to compare all distances and lengths. The pyramid system takes the even $\frac{1}{10000000}$ of the earth's *half* polar diameter, while the French system professes to take the even $\frac{1}{10000000}$ of the earth's half polar circumference.

The American Cyclopædia in its article on weights and measures says that "The only standard which may contend with the French meter for universal adoption is the English inch, which is almost exactly $\frac{1}{50000000}$ of the earth's polar axis, and that the English inch may therefore very properly be regarded as natural a standard as the French meter; and that by slight changes of the inch, this relation might be made exact to the $\frac{1}{50000000}$ of the earth's polar axis, and that twenty-five of such inches making a cubit, would be equal to the $\frac{1}{10000000}$ part of the earth's polar axis." This is the pyramid system exactly, without the slightest variation. And the exact changes suggested would be made by adopting the exact pyramid inch. Is it possible that the writer of this article on weights and measures actually advocated the pyramid system (thinking it was original) as the only system that would ever compete with the French system for universal adoption? Did he not know that he was recommending precisely one of the lessons taught in the Great Pyramid?

The architect of the Pyramid not only knew the shape of the earth and how to measure its surface and diameter, but he knew what it would weigh if it were possible to put it on scales sufficient for that purpose. And strange to say, its weight is correlated to the weight of the Great Pyramid, as appears thus: There is a unit of weight measure in the Pyramid where a cubit inch of average earth, *i. e.* earth at its mean density, is estimated to weigh 5.7 times as much as the same quantity of water at 50° of heat at its own thermal measure. This corresponds very well to the present scientific standard. At this estimate the Pyramid's weight and the earth's weight are respectively thus: Pyramid, 5,272,600 tons, earth, 5,271,900,000,000,000,000,000.

It will be seen at a glance that if this estimate, made by a competent civil engineer, William Petrea, is correct, that the weight of the Pyramid is almost the even one quadrillionth, or thousand-million-millionth ($\frac{1}{1,000,000,000,000,000}$) of the weight of the earth. It is remarkably near it, for the Pyramid has only 700 tons, or a small vessel load, too much to make the measure exact. This is a proportion to such a mass, which is no more than that of the drop to the bucket. If reasonable allowance were to be made for a minute human error, which extended only to the fractions of the numbers which are the factors in the multiple of the earth's weight, it would be sufficient to produce exactness.

It will be seen that this method of measuring solids by the weight of water,

establishes proportionate relations between solid and liquid measures, so that the inter-relations would be, it is said, thus:

1 drop of water = 1 grain.
1 pint = 1 pound.
1 bushel = 1 hundred weight.
1 chaldron = 1 ton.
5 cubic inches of earth = 1 Pyramid pound,

which varies but a trifle from the pound avoirdupois.

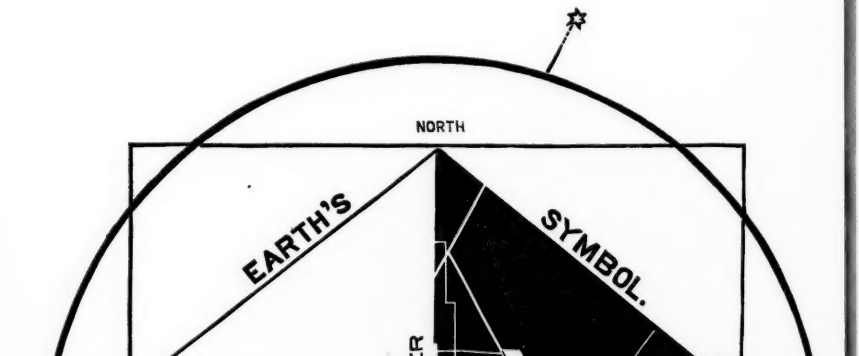
The Thermal ten-division measure of the Pyramid is remarkably simple and comprehensive. It fixes 0° as the mark where water freezes, and 250° as the boiling point. Then, even 50°, which is exactly one-fifth of the distance from freezing point to boiling point, and which is equivalent to about 68° Fahrenheit, is that comfortable degree between heat and cold which is said to be the earth's mean temperature. This 50° point is the exact temperature of the Pyramid's Holy Place, a chamber aired by two ventilators, with walls polished like fine jewelry, where it is said are found the counterparts to sacred symbols in Solomon's Temple, and where the temperature never varies from 50° from one end of the year to another. The table for Thermal measure runs thus:

0° = zero—water freezes.
50° = earth's mean temperature.
250° = water boils.
1000° = iron red hot.
5000° = platinum melts at white heat.

Those who contend that the Holy Place referred to was intended for a sepulchre, might exercise their reasoning powers on the design of ventilators and other peculiar arrangements in a tomb.

This paper has extended far enough for one article, but there is either too much or too little in the problems we have demonstrated, to stop it suddenly. They leave our curiosity unsatisfied, and incline us to walk in and explore its avenues and chambers, its exquisitely accurate measures and workmanship, so perfect that the best optical instruments fail to show defects, and where stone is fitted to stone of exactly equal size, and joined with cement as fine as silver paper, and where it is said can be found the exact pattern of the ark of the covenant of Moses, declared by divine inspiration to have been made after a pattern shown in the Mount, by Jehovah, and not after the then existing pattern, which was like it, but sealed from human view till thousands of years afterwards.

If desired, we may at another time examine, to the best of our abilitv, some of the inside problems, less likely to be fully understood, which it is claimed involve not only science but revelation, including prophecy—subjects too momentous to be disposed of hastily or carelessly. In the meantime, why will not honest and intelligent unbelievers, especially of the evolution stripe, speak out, and give us from their stand-point a reasonable, scientific solution of the problems, which appear now so prominently on the outside of this huge old monumental wonder.



Since the discovery, about forty years ago, in Egypt of two zodiacs, reported by French astronomers to have been used by primitive man, one of them some 17,000 years before the Christian era, and which afterwards, by undoubted testimony on the instruments themselves, were proved to have been made during the reigns, respectively, of Antoninus and Nero, scientists of the skeptical school seem disposed to ignore new scientific discoveries in that country, no matter how important, and at least to steer clear of Egypt.

VESUVIUS AND THE SURROUNDING COUNTRY.

(*Visited March 10th—19th, 1876.*)

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One hundred and twenty-five miles south-east of Rome stretches Campagna, bounded on the north by the Pontine marshes, on the south by the mountains of Calabria, on the east by the foot-hills of the Appenines and on the west by a translucent sea. Upon this level plain are two objects of interest which will claim our attention: one, Vesuvius, a low, solitary mountain by the sea, bounding from a handsome shore to the height of 4,257 feet; the other, a tract of country nearly five miles square and ten miles distant from the volcano. It will be convenient to first consider the general history and character of the latter.

Setting out afoot from Naples (pop. 415,000), a city of the greatest wealth, poverty and population in Southern Italy, one fails not to notice the peculiar soil, the strange color and the stranger texture of the rocks along his way. No sooner is this brown tufa rock seen—a specimen of which is upon the table before you—than his mind, seeking its origin, wanders far back into the unwritten past, when the Mediterranean not only covered the place of his observation but spread away eastward until it washed the feet of the snow-capped Appenines. In that distant age the back-bone of Italy was unbroken from the Alps to Sicily, but this country, so full of scientific as well as historic interest, was then only a back-bone. While surveying the evidences in silence, he images Vesuvius convulsively rising from the temperate Cænozoic sea, tens of thousands of years before the mysterious Sibylline books were carried from Cumæ, whose ruins are almost indistinguishable before him. He knows this tufa to be only the sediment of the red-hot cinder-shower that poured from that early Vesuvius. During the same epoch the site of the Imperial city lay under the tepid sea, whose waters were blackened with the volcanic shower from the neighboring Alban and Cimmian hills. In subsequent centuries the Roman Campagna, with its rich beds of puzzuolane earth—which alone gave durability to the famous Roman cement—and the Campagna about Naples were raised into the sunlight. This account of the formation of tufa becomes more probable, knowing that Signor Guiscardi has collected from the tufa hills of Pausillipo more than an hundred species of shells, but a few of which differ from those now inhabiting the waters that lave the adjacent shores.

That you might better understand the form of Vesuvius and the character of the surrounding country, I have prepared, at a considerable expense of time, a plaster of Paris model of them for a radius of nearly twelve miles. [Prepared from a map by Prof. Phillips, of Oxford, in connection with my own observations.] For the present you will observe this tract, called by the early poets the Phlægrean Fields, lying just west of Naples and literally covered with craters, varying from fifty to five hundred feet in height. Under the varied influences of bright sunshine, fierce internal heat, drenching rain, a balmy air, and a destruct-

ive vegetation, they have descended to us in all stages of perfection, from those whose outlines are barely traceable to those of perfect crateral form, and all are extinct but one. I wonder that so interesting a country is not better known. Here is Monte Nuovo, 456 feet high, an eruption of 1538 and the last upon record in this part of the Campagna. Its sides are covered with scoriæ and blocks of trachyte, and its oval interior is but nineteen feet above the sea. This is Monte Barbaro, celebrated by Juvenal for its excellent wines. Its crater is a mile in diameter and its sides are covered with a vegetation of myrtle, arbutus and wild evergreen, but the activities that raised it are so remote as to span the whole reach of human history. To the north of these are the striking forms of Monte Grillo, Fossa Lupara, and others, but their paroxysms are buried in the deep past. I can only mention Astroni, whose crater is three and a half miles in circumference, around which are discovered only volcanic ashes and mud: its splendid form and interior vertical cliffs unmistakably indicate that where now "the wild boar and wary deer roam amid forests of oak and ilex, slaking their thirst in small lakes half covered with water lilies," was formerly the place of great volcanic disturbance, which, although unseen, is none the less certain. Farthest to the north is the Piano di Quarto, the longer axis of whose crater is but a little less than four miles. A little back of Naples is the Pianura, which, although smaller than the last, yet dwarfs that of the present Vesuvius almost to insignificance. I have said that, with a single exception, these craters are extinct, still, in many places throughout the Phlægrean fields the stranger fails not to discover heat that is not "latent" and volcanic products that are not ancient. From hundreds of crevices long, thin streams of steam, perceptibly hot, constantly pour from the ominous depths from which are deposited beautiful incrustations of sulphur and the deeply contrasted red arsenic sulphide. I must call your attention to this crater, the Lago di Agnano, for not only did it attract the notice of the ancients, but, throughout the long night of the Middle Ages it was an object of curious superstition. It is not a lake, as its name would indicate, as, twenty-five years ago it was drained by an Italian engineer, and now, within its tree-clad cliffs, it presents but little else than a beautiful meadow where graze many flocks of sheep. Within the crater, on the eastern side, the infamous Tiberius built his royal palace by a mineral spring, whose temperature to-day is 180° and nauseous with hydrogen sulphide, while near these ruins, in the crannies of the rocks a few yards away, pure sulphur is being deposited.

But the point of greatest interest is the *Grotto del Cane* (Grotto of the dog), noticed 1800 years ago by Pliny in his scientific writings and not less full of meaning for us. Before leaving Naples I provided myself with waxen strings, not knowing that the grotto was in charge of an Italian who asks all he can get for allowing a person to examine it. I can do no better than transcribe my journal. The cavern, located in the side of the crater, is four feet wide and ten feet high, the floor rapidly inclining from the entrance. The rocks are quite warm, but endurable, and one's feet are soon damp with perspiration. When the door was opened, I noticed a white smoke, a foot deep, pouring out into the plain

(crater)—probably the vapor of water. Advancing a couple of steps into the grotto and lowering the taper to my knees, it was instantly extinguished. With a flambeau of hemp I advanced still farther in the grotto, then, upon lowering it until immersed into the stream of suffocating gas, it was extinguished as quickly as if plunged into a stream of water. Relighting and going still farther into the cave, upon lowering it it was again put out at the height of my shoulder—thus proving that I was standing shoulder deep in the carbonic acid stream which, for twenty centuries has been pouring its floods of death out upon the floor of the great crater. Knowing its ultimate effect upon life, I wished to ascertain how a smaller quantity would affect a person. Telling the keeper that I wished to breathe it, he followed me into the grotto. Burying my head in the invisible gas without breathing it, I felt no peculiar sensation and upon taking a small draught of it into my lungs, I noticed only that the air was a little "close." I then tried two deep inspirations, which produced a roaring in my ears and a dull, boozy feeling in my head, neither of which were painful. Although my vision was perfect, my eyes felt dull and the eyelids heavy. Expelling the gas from my lungs, it was difficult for a minute or two to feel any satisfaction from breathing the fresh open air. I was not satisfied, still, I did not think it prudent to experiment further. The Italian's jolly wife said that a dog would become insensible in a minute and a half—consideration one franc. While holding the watch, the dog was lowered into the stream. In thirty-five seconds its eyes rolled wildly and I ordered it out. Recovering quickly in the fresh air, it was again lowered into the gas, and in fifty-five seconds the animal reeled, but he would not take it out as I ordered, leaving it until it fell, one minute and ten seconds after its immersion. When taken out and laid upon the grass, its body was limber and its eyes were closed. In one minute snuffing and choking commenced, followed by awkward efforts to regain its feet. Soon it moped slowly away and was again capering with its companions on the lawn. The fact is these dogs have been killed so many times for the benefit of travellers that they seem to enjoy it. There is but one explanation of this phenomenon; deep down in the earth's bosom the internal fires warm and decompose the limestones driving off this river of Carbonic Acid. Eleven twenty-fifths of weight of common limestone is this invisible and irrespirable gas, or, forty four pounds in every hundred pounds of rock. The amount of gas thus expelled from the deep subterranean rocks, consequently, the amount of rock chemically and physically changed since the superficial observations of Pliny were made, must be enormous. Thus we have an explanation of the Guevo Upas in Java, or Valley of Poison, a half mile in circumference. It is an extinct crater, strewn with the "carcases of tigers, deer, birds and bones of men," caused by the constant flow of carbonic gas into it. It is no wonder that the crater, Lago Aguano, when filled with water and, as during the Middle Ages, probably covered with carbonic acid gas, should have been the source of much superstition. With still greater force was this true when neither the existence nor the properties of the gas were known, when philosophy was empty theory, and a rigid investigation of facts, which alone determines their principles, a thought that had not

taken hold of the minds of men; and to-day not a few delude themselves in vain efforts to grapple with some of the great scientific questions, absolutely if not professedly ignorant of the simplest details and elementary principles upon which they are claimed to rest.

The craters of the Phlægrean district have consumed much of our time, but I would not omit the most interesting—the Solfatora. It is especially interesting from the fact that from it has flowed the only stream of lava known to the west of Naples. This crater is an elliptical basin of several hundred acres bound by walls one hundred and twenty-five feet high. A path leads across the center to the opposite side, many rods of which echo to the walk as if great subterranean chambers were beneath. The guide picked up a thirty pound boulder and threw it down at my feet, causing the ground to tremble and producing a rumbling not a little startling. Not only under the brier thicket and in the shade of the arbutus was the surface perceptibly warm, but I found several places whose heat could not be endured. Throughout the crater the rocky walls are streaked with yellow, brown, red and white, while the soft floor, mingled with gray and white, abounds with the sulphates of alumina, lime and magnesia. Warned at his entrance, yet he is almost unprepared to witness the strange sight which now meets his eye at the farther end of the crater. Not only does steam, scalding hot, issue from a low, narrow cavern, but the roar of its expulsion is so great that near it, conversation even in a high tone is impossible. For a minute, great volumes pour from the small cavern in torrents, succeeded by short intervals of comparative rest, during which I heard familiar sounds like those of steam escaping from a semi-fluid substance as heard in boiling corn-mush. The rocks within reach are too hot to be handled and they are uniformly incrusted with bright yellow sulphur and beautiful realgar—the latter by no means plentiful. Stooping low and vigorously using the fifteen foot pole to obtain some specimens, one is apt to venture too far and is liable to get the blast of steam and irrespirable vapors full in his face. Upon the cooled specimens I could distinctly taste alum, and salt upon many of them. Who can work out the complicated reactions taking place in the great laboratory below? Leaving, it is impossible not to turn and look at it again, and it is probable that we now view it with the same mingled feelings of admiration and wonder as were experienced by Strabo (30 B.C.) and his contemporaries. Upon the eastern side hollow sounds are heard beneath the feet, and hundreds of small steam vents attest the existence of great energies not far below. Searching for specimens one frequently burns his fingers and, in not a few places, is it too hot for shoes. The story is authentic and the geologic evidences are unmistakable; eight hundred and eighty years ago the Solfatara was an active volcano; flame and cinders poured upward in torrents, while the air for miles around was laden with impalpable dust through which hurtled the lightning's glare, and a stream of lava flowed a mile toward the sea. The small artificial opening ten feet deep near the centre of the crater, is of no little interest. From the soft plaster-like mud escapes the hot steam with a heavy thud, not unlike that heard when a wagon wheel is drawn from the gutter. This escape is periodical, caus-

ing a great splash and producing an insufferable odor, much like that of sulphureted hydrogen. One has abundant opportunity to look down into it and at the proper time he fails not to use an opportunity to get out of its reach. It is strange that this crater, within a stone's throw of the old Appian and public highway, has not been thoroughly examined; were it in the United States the people would have it all excavated in two weeks, and upon the third would have a nice current of red hot lava flowing into the bay; but these filthy, lazy, intensely religious and ragged Italians take no interest in the matter whatever. Upon analysis of these vapors by Dr. Danberry, of Oxford, he found chlorhydric acid, ammonium chloride, hydrogen sulphide and aqueous vapor, but there seems to be no agreement as to the exact kind of chemical relations which produce them. The citations of ancient authors, tabulated by Prof. Phillips, render it probable that twenty and more centuries ago the Phlægrean Fields were in the same mingled state of activity and repose; and, considering the little interest in the various subjects of natural history, it is no wonder that their philosophy should contemplate in this tract "ominous lakes, hot springs and sulphurous vapors," significant only of conflicts between the giants and gods. I will only mention that this model reminds us of that volcanic tract on the upper "horn" of the half moon whose craters are numerous and whose dimensions are surprising.

Here is Monte Nuova at whose base lies Cumæ, the most ancient of the Greek cities of Italy, and the Lucrine and Avernian lakes. This eruption of the sixteenth century effected many changes in the geography of the district, as villas were overwhelmed, the area of Lucrine lake diminished by one half, the town of Tripergola blown into the air, and every vestige of the wharves of Agrippa were destroyed. Preceding its elevation twenty-seven earthquakes shook the Campagna, an additional two hundred feet of the shore were raised into the warm sunlight, but the miserable and starving poor continued to gather the stranded and struggling life. Soon the volcanic fires broke forth; the heavens were darkened with ashes and cinders; lightnings rent the all but universal gloom and shook the air, and the inhabitants of Puzzuoli, affrighted and petitioning their saints, commenced their wild flight toward Naples, whose palaces, five miles from the eruption, were befouled with the descending mud. At its western base Lake Avernus, nearly circular and surrounded by high steep ridges covered with evergreens and oak trees, seems a deep hollow scooped out of the hills, and were it not for two hundred feet of water its crateral form and origin could not have been mistaken. Lucretius' story that in his time the lake was dark and gloomy and that birds attempting to skim its surface would fall dead by the noxious gases, is not at all improbable when we remember the neighboring Grotta del Cane. It would be difficult to select a more pleasing sight than Avernus, above whose dark unruffled waters sea birds gaily skim the surface beneath an azure dome. At about this point, midway between the two lakes on the right, was the cavernous entrance to the Infernal Regions, where answers were returned by the dead, to which Ulysses came, while in the immediate neighborhood was the abode of the Cimmerians. Of this place did the early poet write

"Dark was the cavern, wide its jaws of rock
By the black lake, and woods of mighty shade."

Not all this is poetic fancy, for the cavern is still there, extending several thousand feet beneath the hills, believed by some unpoetic people to have been only a public road to Cumæ. In a bluff by the sea, a mile beyond the Lucrine lake, are the baths of Nero. Many yards can one penetrate this dark cavern until the steam, scalding with heat, not only stops his progress but again reminds him that the great stores of heat are beneath. Farther to the south are the shores of Baiæ, along which stretched some of the splendid temples and palaces of the ancient world. Strange does it seem, within the roofless temple of Venus whose walls, once of the rarest marble, yet tower to a height of seventy feet, and whose pavement was costly mosaic, to see old broken down wagons and hear the ring of the blacksmith's anvil! Farther are the ruins of Bauli where Nero planned the death of his mother, the rocky Cape Misenum and the Elysian Fields.

On the north shore of the Bay of Baiæ is the ancient town of Puzzuoli. It was here (Puteoli) that St. Paul tarried for seven days, and the more than matricide emperor practiced upon the stage. I can not now describe the ancient amphitheater and the other many things of scientific and historical interest, except to notice the old bath house of the Romans—called in more dignified language the Temple of Jupiter Serapis, from a statue found among its ruins. You must imagine an open area—one hundred and fifteen by one hundred and thirty-four feet—on a level with and near by the sea-shore, strewn with slabs of porphyry, portions of granite and marble pillars with their ruined capitals, the whole surrounded by forty-two compartments, only a few of which are well preserved. Not far from the center of this area are three erect pillars of marble, whose plinth is under water and whose entablature has long been wanting. Its surface is thickly studded with the perforations of lithodomous shells—some of which will admit the little finger—to a height of twenty-three feet. Since its exhumation in the eighteenth century this structure has engaged such scientific minds as Professors Forbes and Babbage, the poet Goethe and Sir Charles Lyell, whose combined researches result in the following conclusions: First, the adjoining Bay of Baiæ, during the last eighteen centuries, has been undergoing a double movement of depression and elevation. Second, this vertical movement has been so gradual as to escape observation. Third, the pillars were bored by mollusks when they were beneath the sea. Many observations along the coast confirm the view that, during the centuries of the past, the country has been rising and falling like the movements of human respiration. It is claimed by a high authority that there is abundant evidence of its having descended two feet within the past hundred and twenty-five years, at which continuous rate the Phlægrean Fields and Compagna may again be submerged hundreds of feet beneath the victorious sea. Evidently there was a time when these waters did not cover so much country for beneath the bay is an old Roman road connecting Pozzuoli and Baiæ. I must only mention the volcanic islands of Procida and Ischia, lying just outside of Cape Misenum, which were settled by the Greeks at a time antedating our own

era by many centuries, but finally abandoned by them on account of the great eruptions. Again they were colonized by Hiero, King of Syracuse, (B. C. 380,) but a fortress having been constructed the volcanic fires were again rekindled when the Greeks abandoned them forever. The last eruption known was in (1302) the fourteenth century, and to-day these rich islands supporting a population of fifty thousand souls, abound with thermal springs, sulphurous fumes, steaming vents and extinct craters.

Let us study the country to the east of Naples. For thirty centuries have Chalcidensians, Oscans, Samnites, Romans, Normans, and Italians successively hovered about the rich Vesuvian slopes, made the Campagna a fruitful garden, filled it with prosperous villages, adorned it with splendid palaces and temples and paved it with excellent roads. To-day, immediately around its thirty mile base, are eighty thousand people, cultivating the soil, clipping the vine, gathering the oil and singing their erotic music in the very clouds of Vesuvian vapor. A description of the physical structure of this volcano is not a little difficult, but this model will give you at a glance an idea of its form and surroundings. Allow me to condense its history. Far back in the past, beyond the farthest reach of written history, Vesuvius was a solitary cone rising out of the Campagna by the sea side. In the war of the Romans against the Samnites, (fourth century B. C.,) when the former sailed up the Sarno, which skirts the eastern base of the mountain they beheld upon its slopes a luxuriant vegetation, and afar toward the crater the vineyards bore their loads of fruit, above which low green shrubs and tangled briers nearly concealed the true character of the underlying soil. An epigram by Martial reads—

> Here verdant vines o'erspread Vesuvius' sides;
> The generous grape here poured her purple tides.

To this place came the Thracian gladiator (B. C. 73) with his brave comrades, having escaped from their bondage at Capua to the north-west. Ascending the mountain by means of bushes twisted together, they lowered themselves into the well-grassed crater. Neither historian nor poet has left a suspicion of smouldering activities beneath the mountain, and not until A. D. 63 did the dense population become aware of the mighty energies beneath them. Then the earthquakes made great openings in the Campagna, destroyed hundreds of sheep, split many statues, killed many people, drove many insane, leveled not a few palaces and laid the historic city of Pompeii in ruins. The sixteen following years passed away with occasional warnings, until the 24th of August, A. D. 79, when, a little after midday, a tree-like column of black smoke poured from the crater for the first time in the annals of history—the world knows the rest. Before the sun had half reached the horizon, midnight darkness prevailed For eight days lightnings flashed through the universal gloom and torrents of rain fell from the condensing clouds; suffocating fumes poured from a thousand crevices; cinders, ashes, lapilli and mud showered upon the Campagna, burying five cities beneath the liquid mass. Not until recently have the topographical changes effected by that eruption been carefully determined. More than three thousand feet of the upper

part of the cone were blown into the air, and of the remainder, that half toward the sea was torn from its foundation to within sixteen hundred and fifty feet of its base, burying beneath the debris the towns of Oplontia, Teglanum, Stabiae and the considerable cities of Herculaneum and Pompeii. Contrary to what has generally been supposed, neither the surface configuration nor the few accounts of it sustain the view that lava flowed at that time, and for upwards of a thousand years (A. D. 1036) the flow of melted rock was unknown to the inhabitants of Campagna.

What is the present condition of Vesuvius? On sixty-five different occasions has lava flowed from the volcano during the last eighteen hundred years, and more than half of these within the past two hundred and forty years. Among the more important changes is the superposition of a new cone upon the shattered old one, but not sufficiently large to completely take the place occupied by the old one; the result is an open space called the atrium, one-half to three-fourths of a mile wide and three miles long, between the new cone and that part of the old one—called Monte Somma—not destroyed in the first century. So, too, on the side toward the sea the external surface of the new cone is not even with the old base, thus leaving a circular horizontal plane—the Pedimentina—many rods wide and sixteen hundred feet above the sea.

Ascending Vesuvius from the south side one takes great delight in selecting points of interest and admiring the magnificent prospect spread out below him. Eight miles due west of the crater is Naples with its ragged half a million, and from it to Torre del Annunziata, a distance of ten miles along the coast is a continuous village street over which the great black cone towers threateningly. South-west of the volcano at its base by the sea shore, is Herculaneum, buried from seventy to one hundred and twelve feet beneath the present village of Resina by six different streams of lava, and in the same straight line are the thriving towns of Portici, Torre del Greco and Annunziata. Just five miles away to the south-east is the walled city of Pompeii, whose hundred and sixty-one acres, silent beneath its twenty-four feet of ashes and cinders, are but one-third exhumed. Within the limits of history no lava stream has ever reached this celebrated city, although it rests upon an old leucitic current. Near it is the river Sarno, taking its rise in the mountains of Calabria, and a mile to the south-east is the buried city of Stabiæ, where the naturalist Pliny lost his life. From the rocky Cape Misenum, where he had charge of the Roman fleet, he crossed the Bay of Naples to this place where he was suffocated with the sulphurous fumes—his route being indicated upon the plan. Beneath its load of volcanic cinders excavations have furnished numerous papyri, statues and architectural designs, and the present town of Castellammare, above its ruins, is still famous for its carbonated and chalybeated waters. On the western slopes of Vesuvius and nearly half way to the summit is the observatory founded by Melloni in 1844. It is a fine two story structure built of lava and located upon a projection from the Pedimentina, at an altitude of two thousand feet. At present it is under the directorship of Prof. Palmieri, and is well equipped with self-registering instruments, the principal object being to record the phenomena that "precede, co-exist with and follow the eruption."

By various instrumental means the direction, intensity and continuance of the earth movements are recorded with the utmost accuracy and certainty. Long does one gaze from the Pedimentina down upon the Bay of Naples, which, more like an inland sea, washes the feet of the fiery monarch with a liquid azure indescribably soft and beautiful. To the right is Naples, beyond which, upon the hills of Pausilippo, repose the bones of Virgil, the great master of hexameter, whose song beginning

"Tityre, tu patulæ recubans sub tegmine fagi,"

the world will not soon forget. Still farther are the Phlægrean Fields, and forty-six villages of the Campagna, covered with areas of light and shadow that move as noiselessly as the dream of a poet. Southward is Capri with the sinking palaces of Tiberius (erected A. D. 37) covered with and surrounded by the rocky walls of nature's own imperial masonry. Spreading level away with an uninterrupted sweep, and bounded on the southwest by volcanic Ischia and its companion isle Procida, the splendid waters disappear in the open sea. Westward rise rugged mountains, and their beautiful coast is none other than that of Meta and Sorrento extending arrow-like under a dome of lapis lazuli.

Upon this relief I have attempted to represent the streams of the seventeenth, eighteenth and nineteenth centuries, four eruptions belonging to the seventeenth, twenty-three to the eighteenth and twenty-five, thus far, to the nineteenth. So startling is the impression experienced when viewing for the first time these varied and desolate streams, that he who has read the theory and has afterward become practically acquainted with the details of any department of science, well knows the crushing weight of an argument derived from the latter source compared with that of the former. The mental state effected by the study of an *object* is separated by a wide gulf from that condition of mind produced by studying what some one says about it. There is no mistake; literature, history and mathematics for their acquirement require the exercise of fewer intellectual faculties than those of the natural sciences. Worthless is the opinion of that individual, in these latter departments, the development of whose powers of sense—perception, has not kept full pace with that of the judgment and reason. Speaking generally, the streams of the seventeenth century have flowed from the south side of Vesuvius, entering the sea in twelve distinct channels. One of the most memorable eruptions occurred in 1631, after rumblings and earthquakes of six months' duration, when the lava broke forth and poured down the south-western slopes in seven grand cascades of fire and mud, destroying a part of Torre del Greco, burning Resina to the ground, boiling multitudes of fish along the shore, and destroying many thousand people. So frequent have been these hot mud streams that they are often more dreaded than the currents of lava. You will notice that the flows of the eighteenth century have bursted not only from the southern side but from the eastern and western as well, here and there overlapping those of the previous century, but reaching the bay in only a single mouth. Among the more prominent of these is the eruption of 1794, at which time the glowing rock poured down the slopes with a solid front twelve to fifteen hundred feet wide, through the streets and alleys of

Torre del Greco, destroying four hundred lives and forcing its way more than three hundred and fifty feet into the sea. During the present century eruptions have been more numerous than at any other. Not only do they cover the Pedimentina, but from the crater they have flowed in every direction, but reaching the sea in two distinct channels a half mile apart. But the most remarkable stream for length is that which poured out of the atrium toward Naples, in a condition not greatly unlike fluid iron, reaching a point six miles from its source—the longest stream known in its history since the eruption of A. D. 79.

It is ten minutes past twelve while I sit upon one of the loftiest points of Monte Somma. The deep and desolate atrium is far below, while tremendous volumes of steam roll upward from a crater (seven hundred and fifty yards) nearly a half mile in diameter. No language can describe this sight, it is almost terrifying. At first I stepped behind some rocks, involuntarily breathing full and irregularly with an oppressive feeling I have never elsewhere experienced. The tiresome ascent of Somma having been completed, I expected to look across a narrow gulf upon a smoke stack, but through the driving clouds I saw a naked cone higher than the point upon which I stood, black as the darkness of midnight, and while exhibiting no signs of life it was all life. Expecting to witness but a mass of steam as from a caldron of boiling sap, I was filled with silent astonishment before the mountainous billows of fleecy vapors rolling slowly, majestically toward the skies, then swept sharply away by the driving winds. Somma, ascended for security, seemed but a toy above an energy capable of dashing it to atoms upon the surrounding plain. The precipice abounds with ragged projecting rocks of lava, fiery and variously colored, while its shelvings are filled with scoriæ and volcanic sand. For eighteen hundred years has Somma stood unchanged between the hot rain shot from the reddened throat of Vesuvius, while floods of liquid rock poured down through the atrium. Many dikes are visible while making the descent, their dimensions being from a few inches to twelve feet wide and from a few feet to five hundred in height, reminding one how inconceivable must be the forces that can thus split a mountain and fill the openings with melted rock.

Having made the dangerous descent into the great gulf which separates Somma from the cone, I thought of the Lachine Rapids of the St. Lawrence, just above Montreal. Were they instantly frozen, preserving their billowy surface, they would but poorly represent this dark, desolate and forbidding place. These now cold but once fiery floods remind one of shapeless masses of mud, with this difference, that the former are sharp, hard and extremely rough, while their masses, an inch to ten feet in height, are so intolerably ragged that one is in constant danger of spraining his ankles or cutting his hands by little falls. Were a thick dough of corn meal rapidly stirred, then quickly dried so hard that it would ring under the hammer, in some respects it would simulate a lava current A striking feature of the current is, that while flowing upon a level surface, instead of spreading out like water, it erects its own boundary walls by the rapid cooling of its sides. It is said by observers of the living current that the slowest river of a plain moves faster than a lava current upon a considerable slope. Issuing from the volcano its tem-

perature is about 2000°, but, at a distance, the cake-like and curled masses indicate the molasses like character of the fluid. The scoriaceous and jagged surface abundantly testify to the slatic pressure of the fluid and the exhalation of its contained gases. One fails not to notice the few boulders of various dimensions, several inches to three feet in diameter, from brown to bright yellow, covered with a slaggy matrix, but broken open, presenting a pleasing and attractive relief upon the sombre, lifeless waste about them. Are these volcanic bombs, once torn from the strata beneath the mountain, shot from the great crater and shattered by the fall? Along the course of a current it would seem that its motion was frequently arrested for a moment, where it would heap, forming a bag or pocket ten feet in height, subsequently parting upon one or both sides, through which break the lava would pursue its destructive course. Continually is one stopping to examine these bag-like masses, botryoidal surfaces, tabular areas, curvilinear forms, and strange prominences, which occasionally assume some of the most fantastic outlines, and which would afford secure retreats for animals as large as the cat and dog. With great interest does one trace a single stream from the Atrium down the gentle slopes, through cultivated gardens, fruitful vineyards, orchards of olives and the golden fruit. Before you are many specimens of lava, collected both from Vesuvius and the giant Ætna. At the close of the evening you will have no difficulty in knowing those which were knocked from the surface of the current as they are rough and deeply cracked, while those specimens which came from the body of the current, not in contact with the air when in a melted state, are dense in structure while their rounded cavities will indicate the position of the cells which imprisoned the gases. This light, cylindrical specimen was evidently a bomb which came from the upper cone. Little or no pumice is found about Vesuvius, this piece and the most of our commercial article being obtained from Stromboli, whose fires have never for a moment been quenched since the earliest recorded history. An analysis of lava shows its general composition to be a silicate of alumina, combined with iron protoxide, potash, soda and lime. But the lavas of different centuries, if they do not differ in chemical composition, certainly vary in their physical properties. It is not a little striking, while walking over these lava fields to see a stream, cold, naked and forbidding as when it flowed a century ago, while another beside it, that flowed half a century later, is covered with a crumbled powdered surface, where atmospheric vapor and the rock moss have thoroughly prepared the way for the growing vine. In many specimens you will discover crystals of leucite, olivine and sodalite, but these perfect crystals of pyroxene I collected from Monte Rossi, an eruptive cone upon the southern flanks of Ætna. This single specimen of dolomite is found in considerable quantities about Monte Somma, but is wanting in the lavas of Vesuvius. If, as mineralogists tell us, obsidian is formed by a rapid cooling of lava, it is difficult to understand why none is found here, for the conditions of its formation would not seem to be wanting. This handsome specimen enclosed in its gray matrix, is owned in this city by Mr. Wilhite, who found it in Oregon of our own country. Many persons would call it a lump of dark glass. No single locality upon the earth's sur-

face has furnished so many simple minerals as the lavas of Vesuvius, and it can no longer be doubted that their manufacture in the great laboratory of nature is far from an extinct process. Here, Haüy, the founder of our system of crystallography, picked up no less than eighty simple minerals, but among these no native metals have ever been found.

From the uneven crater of this volcano destruction and death have poured for centuries. Different was the scene twenty-one and a half centuries ago, when the Roman fleet under Regulus, made its way to Carthage. Then the checkered vineyards extended far toward the summit, and the wild boar hid among the thickets of the crater. Now it is full of cloud-like steam of fleecy whiteness, which rolls to a great height when it is swept by a stiff breeze over the suffocated dead of its old victim—Pompeii. At no time is it possible to see across the great crater, so dense and continuous is the steam. Occasionally I saw its vertical walls, tinged with red, yellow and brown, and the shelvings of the rocks are heaped with black volcanic cinders. At Naples, eight miles away, the vapor seemed to rise but slowly; but here beside it, it rises majestically upward in great torrents, impelled by energies that do not sleep. Walking from the windward side around to the south margin whose width varies from twenty to seventy-five feet, I found the steam sulphurous and irrespirable, exciting violent coughing. The summit of the crater abounds with banks of nearly pure sulphur, rocks of variegated color, and volcanic cinders. Many portions of the surface are smoking, and not a few square rods are too hot for the soles of the boots. One delights to throw rocks into the crater from whence they came, and stepping away from the precipice, to dig into the noisy cinders where evidences of great heat soon become manifest. A guide, conducting an English party, placed some eggs in jets of escaping steam, which soon rendered them palatable. Thrusting a paper under a rock, it immediately took fire. Fifteen feet from the precipice, beneath a layer of cinders, I found the rocks incrusted with sulphur, sal-ammoniac and cubic crystals of sodium chloride, several times burning my fingers while throwing them into the air. Placing my green stick used for a cane, in a crevice, it cracked as in a stove, and in three minutes by the watch, I withdrew it all aflame.

One never tires seeing and toying with the great energies whose source is far beneath him, but whose origin lies in nebulous aggregation. One is impelled to think beyond his naked observations, and he fails not to ask: Whence this salt, which one tastes, upon the rocks? Immediately he descends far into the bosom of the earth, where he witnesses the scalding conflict between the rocks, half reddened by internal heat and the salt water that has poured through the creviced earth from the great Mediterranean above. A simple calculation from the quantity of steam continually poured from the crater, gives a result not easy to anticipate. A cloud, one half a mile diameter and two miles in length, condensed to saturation at 40°, represents about 20,000 cubic yards of water. Now, allowing that this vapor rises and floats away at the rate of four miles an hour, in a single day more than enough water would pass into the atmosphere to cover 104 acres to the depth of five and a half feet. Thus, in order to form a conception of one of the

probable causes of volcanic action, the imagination must enable us to realize this quantity of water making its way down through the crevices beneath the adjacent sea. Understanding this fact, the difficulty of perceiving the cause of the destruction of Herculaneum is greatly removed, when we think of the descending shower and the torrents of mud that must have succeeded it. If further evidence of the sinking of the Mediterranean waters were needed, it will be necessary only to state that fish have been found in the mud vulcanoes of the Caspian. Admitting this, the formation of hydroxides and hydrosilicates is no longer an enigma. This theory possesses a high degree of probability when we remember that the active volcanoes of the world are located near bodies of water. Thus are arranged the 28 active volcanoes of Java, the 109 between Australia and China, the thirty in Guatemala and S. A. Republics, the twenty (20) active volcanoes that separate the Atlantic from the North Polar Sea, the giants of the Sandwich group, Mount Erebus and Terror of the Antarctic continent, and in southern Europe, Santovin, Vesuvius, Volcano, Ætna, and, lastly, Stromboli, ever white with steam by day, and at night bright with his red glare. Equally striking is the correlative fact that, inland from these active volcanoes are extinct ones—instance those in eastern France, Northern Italy, in the Appenines east and southeast of Rome, and Mount Vultur, 80 miles east of Vesuvius. Throughout the 22,000 mile circle of fire which encloses the Pacific, all of its 225 active volcanoes as well as the remaining 75 in other parts of the world (Mayer) are not distant from the sea. Whether, as Lyell maintained, volcanoes rest upon a line of fracture, is a disputed question, but the synchronous, alternate and irregular phenomena of various volcanoes are hardly decisive.

While standing beside the Vesuvian current of flowing lava in 1819, Sir Humphrey Davy, of the Royal Institution of Great Britain, propounded a theory which, although subsequently rejected by him, exercised no small influence over the men of his time, it being advocated by Dr. Danberry of Oxford, in his great work on volcanoes. It was very simple, supposing only the existence of free alkaline metals in the earth to which air and water have ready access, resulting in heat and the ready flow of lava. Expressed in a concise manner, his explanation of volcanic action was the assumption of deep seated chemical action. As an illustration of his main thought—that of chemical action—I wish to perform an experiment or two. The possibility of chemical action being sufficient to produce volcanic phenomena must be admitted by every experimenter in physics, but the great improbability of free alkaline metals or their earths (?) existing in sufficient quantities at so great a depth or at all, is striking to the most superficial person. Perhaps the most plausible theory is that which is ascribed to volcanic action, to the existence of a fluid interior whose energies slowly radiate into space and whose shrinking nucleus is the source of earthquakes, explosions of liquid rock, and the elevation of mountain chains. While considering physical theories of any character, we must not forget that without acute, persistent, general and systematic observation, they are to that extent speculative and worthless. Not after observatories have been established upon the trembling sides of the volcanoes

themselves, and the areas of disturbance throughout the world have been provided with seismological instruments that will automatically record the time, direction and intensity of the subterranean forces, may we hope to lay a foundation substantial for future progress. Too many persons undertake the grandest and far-reaching generalizations, their cotemporaries freely accepting or rejecting them, without a competent knowledge of the elementary facts and principles upon which they must be based. Not only in the acquirement of science, but in the advancement of its state a personal knowledge of facts must precede that of its principles and the latter that of its laws, otherwise we may not approach nearer the truth than the ancient Romans who ascribed these phenomena to the struggling of giants overthrown by lightning from heaven, which outstretched them beneath the volcanoes whose eruptions attest the success and sincerity of their efforts for release. We may not, like the natives of Java, annually pour rice into the crater of the Sumbing to appease the God of Destruction, nor, as did the Neapolitans for centuries, march in solemn religious procession behind the elevated bust of St. Januarius toward the invisible devil, quite successfully threatening in the crater of Vesuvius, but unless scientific questions are attacked with method, and a confidence in the uniformity instead of the confusion of law, we shall make no greater progress than they.

Laying aside the deep seated causes there is no concord of opinion regarding the formation of the visible part of the volcano. Conceal the upper portion of Vesuvius, we then see a truncated cone whose base sweeps the sea and beautiful Campagna in a circuit of thirty miles. No one questions that the cone above the frustum was formed by showers of volcanic sand, cinders and lapilli, mingled with melted rock that rose from the crater—in other words, is an accumulation of matter from some point far beneath the earth's surface. A competent authority regards it highly probable that in the smoke, ashes and cinders of Vesuvius have been carried away over the sea ten times as much matter as covered the neighboring cities and deluged her flanks. No one doubts the truth of Dryden's conception

> "By turns a pitchy cloud she rolls on high,
> By turns hot embers from her entrails fly
> And flakes of mountain flames that lick the sky.
> Oft from her bowels massy rocks are thrown,
> And, shivered by the force, come piece-meal down."

But is it true, as Humboldt and Von Buch asserted, that volcanoes are formed by an upheaval of strata which are subsequently covered with lava, or, shall we believe with Saussure and Lyell that the frustum is formed as the upper cone is formed—by an accumulation of material? This question, like most others in life, must be decided not by an appeal to honored and reliable "authorities," but by a conscientious appeal to *facts*. The few observations made on this subject are decisive for the theory of accumulation. It is well known that the diameter of the crater and its height above the sea are continually changing, and it is probable that after it has many times blown the crater high into the air, it will finally fill the atrium to the very walls of Somma. We forget that the height of the vol

cano is very variable. The first barometric measurement of Vesuvius was made in 1794 by Abbe Nollet, who ascertained it to be three thousand three hundred and twenty-six feet in height. Twenty-four years later it was measured by Prof. Forbes who found that it had gained five hundred and sixty-eight feet, but in 1805 when Gay Lussac measured it, Vesuvius had lost thirty-eight feet from its last measurement. In 1822 it was measured again by that great scientific traveler, Humboldt, whose result was four thousand and twenty-two feet, and subsequently by Schiavoni in 1863, who determined that it had gained one hundred and forty-five feet since the time of his predecessor. The last measurement was made by Prof. Palmieri, of the University of Naples—the altitude being four thousand two hundred and fifty-seven feet. But these changes in altitude have likewise been accompanied by changes in the diameter of the crater which has oscillated to measurements greater and less than half a mile for a hundred years. Near the close of the last century its diameter was eleven hundred yards; in 1822, one thousand three hundred and twenty yards; in 1855, six hundred yards, and in 1861, seven hundred and fifty yards. These changes are constant, sometimes lowering its altitude, at other times rendering it more commanding, but enlargement is the tendency, and some time in the distant future it will have expanded so as to cover the Pedimentina, fill the great atrium, and at length assume the form and height of Vesuvius as it was in the days of heroic Spartacus and the epic times of Homer. To this future will succeed another in the Psychozoic, when to her beautiful shores there shall have been added other lands now beneath the adjacent sea; then will it be witnessed far inland, solitary as now, its stony and forbidding flanks decomposed to a rich soil, its smokeless cone washed with every storm, but its changeful physique, like its predecessor, Mt. Vultur, a long testimony to the energies that once filled it, a silent monument to the dense but forgotten populations that slept beneath the lavas or hovered about her base.

FOREST-TREE BORERS.

BY MARY E. MURTFELDT, KIRKWOOD, MO.

The insects that openly attack the staple crops of the field and orchard, are but few in kind, compared with the almost countless species that more indirectly but none the less surely militate against our enjoyment and our pecuniary interests.

Among the most important insects of the latter class are the forest-tree borers. The rapid decadence of our forests, so noticeable in many sections of the country, and the unreliability of indigenous shade trees around our dwellings, is in a large measure due to the insidious work of these insects.

Many of the most destructive species are of the utmost insignificance individually; but in the aggregate, become a formidable scourge, before whose attacks the stateliest monarchs of the forest fall into ruin, often within a single year.

The described species of American forest-tree borers number several hundreds; but the greater proportion of the injury is done by not more than twenty-

five or thirty species, all of which are included in the order *Coleoptera* (beetles). A few boring larvæ occur in the orders *Lepidoptera*, (butterflies and moths,) and *Hymenoptera* (four-winged flies); but, as a rule, the beetles enjoy a monopoly of this sort of work.

The wood-boring beetles belong to several widely different groups, and are classified according to their habits or structural peculiarities, as bark-borers, wood weevils, saw-horn borers, or *Buprestians*, and long-horn borers or *Capricornes*.

The bark-borers are all included in the family *Scolytidæ*, and are characterized by their hard texture, polished black, or dark colors, short, clubbed antennæ, and by their nearly cylindrical form which is truncated either squarely or obliquely behind. Few of the American species exceed one-fourth of an inch in length. Both sexes of these beetles bore into bark; the males in quest of food merely, and the females for the additional purpose of laying their eggs. The latter are placed on either side of a vertical burrow, cut partly in the inner bark, partly in the sap wood. The larvæ are fleshy, wrinkled, legless grubs, closely resembling curculio larvæ, and, like the latter, always rest in a curved position. They bore transverse diverging grooves, forming fanciful patterns on the inner bark, and corresponding ones on the sap wood. These burrows, which in the rear of the grubs are filled with powder and chips, cut off the circulation of the sap, and when, at all numerous, speedily cause the death of the tree. The grubs attain their growth during their first summer and remaining dormant over winter, change to pupæ in the spring. The beetles issue soon after, through small, round holes in the bark; badly infested trees presenting, after their emergence, "the appearance of having been peppered with No. 8 shot," as Prof. Riley remarks in reference to the Hickory Scolytus. The species belonging in the genera *Hylurgus* and *Tomicus*, are mainly injurious to pines and other evergreens; while those included in *Scolytus* attack, for the most part, hard-wooded, deciduous trees. *Scolytus 4-spinosus*, of Say, bores the hickory and pecan, and although a small species, is, on account of its exceeding prolificacy, one of the most destructive timber pests, and has been known, in many instances, to cause the death of entire groves of valuable trees within a single season. It works by preference in young trees and in the tops of the larger ones, where the bark is most penetrable. Nature has fortunately provided a check upon the increase of this insect, in the shape of two small parasitic flies, which penetrate to the grubs, through the holes made by the parent beetles, and lay their eggs upon the bodies of the former, which the fly larvæ, upon hatching, proceed to devour at their leisure.

The wood weevils include but few species of the Snout-beetles, (*Curculionidæ*,) as this family is mainly composed of species that inhabit fruits, nuts and grains. Those which live in wood are similar in their habits to the true Bark-borers, but are readily distinguished from them by the prolongation of the front of the head into a straight, or curved stout beak or snout, upon which are situated the elbowed and knobbed antennæ. They are chiefly injurious to trees of the pine family. The larvæ of some of the species bore the pith of the twigs and smaller branches, while others gnaw galleries under the bark, similar to those

formed by Scolytus, only not so fanciful in design. One species of *Magdalis* affects the willow and another inhabits the elm.

The Saw-horn Wood-borers or Buprestians include many of the most pernicious species. They are easily recognized by their flattened, oblong form, hard texture, metallic colors—generally brighter beneath than above—short legs and rather short, serrate antennæ. They are diurnal in their habits, and the trained observer often comes across them basking in the sun, during the middle of the day upon the trunks of the trees they infest. When disturbed, they instantly draw up the legs and drop to the ground, after the manner of the Snout-beetles. The eggs are laid in crevices of the bark, through which the larvæ penetrate to the sap-wood. Here they work during their earlier stages, but upon approaching maturity cut channels in all directions through the solid wood. The larvæ of the Buprestians are at once distinguished from all other wood-boring larvæ, by the excessively enlarged and depressed first-joint, into which the small head, with its dark, horny jaws, is partly retractile. The second and third thoracic joints diminish rapidly in size, and the hind body presents a comparatively attenuated appearance.

Our largest species, *Calcophora* (*Buprestis*) *virginiensis*, is about an inch in length, of a blackish color with coppery reflections. Its larva bores the trunks of the pine, causing considerably destruction in pine forests. *Dicerca divarica*, of Say, which infests the wild cherry as well as the peach, is about three-fourths of an inch in length, copper colored, with a granulated surface, the tapering wing covers terminating in two blunt projections. The larva of a much smaller and more inconspicuous species, *D. lurida*, bores the hickory. The most numerous and most generally destructive insect of this family, is the well-known "flat-headed borer," the larva of *Chrysobothris Femorala*, a brassy black species, about half an inch in length, familiar to all fruit growers as a dreaded orchard pest. This species not only attacks the apple, peach and other fruit trees, but is particularly destructive to oak, hickory, wild cherry and soft maple, annually causing the death of a considerable percentage of these trees, the timber of which is rendered useless for any other purpose than that of firewood, by the numerous channels cut through it in all directions by the grubs, All the Buprestians complete their growth and transformations within a year—the beetles appearing early in the summer, and laying their eggs for another generation of destroyers.

The last family of beetles to be considered in this connection, are the Long-horned or Capricorn beetles (*Cerambycidae*). These are characterized by an elongate, rather slender, sub-cylindrical form, long legs and especially by the long, tapering antennae, which are curved forward or backward or waved gracefully through the air. Many of the species display beautiful colors and are adorned with stripes and spots dispersed in elegant patterns. When captured, or in any way excited, these beetles make a squeaking sound, by rapidly rubbing the first joint of the thorax against the second. Upwards of five hundred American species are described, although the larval habits of a considerable proportion of them have not yet been investigated.

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The larvæ are prëeminently wood-borers; none of the species, so far as known, living externally on plants or feeding on anything else, besides ligneous tissue or pith. They are elongate-oblong, yellowish-white grubs, with small head and strong jaws, admirably fitted for drilling through solid substances. The incisions between the joints are deep and the diameter nearly uniform throughout, the thoracic joints being but slightly enlarged. The majority of these larvæ are provided with six pointed, scaly legs, one pair on each of the first three joints; while a few are entirely destitute of legs, or have the latter represented only by three pairs of tubercular points. Some of these species complete their development within a single year, while with others, two or three years elapse between the entrance of the larva into the tree and the emergence of the beetle.

The hickory is bored by a greater number of distinct species of Longicorn beetles, than any other of our forest trees. Conspicuous among these is the Banded Borer (*Cerasphorus Cinctus*). This species is over an inch in length, with very long curved antennæ. The color is a pale gray-brown, each wing cover being ornamented with an oblique, curving band of dull ochre-yellow. The larva, after entering, bores with the grain of the wood, occasionally cutting a channel transversely to the surface, for the ejection of its castings, and, finally, one for the exit of the beetle. Many pieces of timber designed for manufacturing purposes are spoiled by the unexpected advent of this beetle; and it not unfrequently damages manufactured articles, by cutting its way out of them, often at the very point where strength and solidity are most requisite. Another almost equally pernicious borer, is the Painted Clytus, (*Clytus Pictus*), a large, velvety-black species, elegantly ornamented with straight, curving, and v-shaped transverse stripes of sulphur-yellow. This species is undistinguishable in appearance from the common locust borer, (*Clytus Robiniæ,*) whose ravages have, within the last fifteen years, almost exterminated that once popular shade tree, the black locust. Another still larger and more gaily colored species of the same genus, (*Clytus Speciosus,*) is very destructive to the sugar maple; while a fourth (*Clytus Capreæ*) infests the trunk of the ash.

The walnut is bored by the Red-shouldered Apate, (*Apate Bassilaris,*) a handsome black species, having the bases of the wing covers red.

One of the species most common in oak is *Asemum Mœstum*, a small, dark brown insect, whose larvæ are said to require two years for their development. The Oak Pruner (*Elaphidion Parallelum*) is very destructive to the smaller branches, not only of the oak, but of a great variety of forest trees. The beetle is a slender, inconspicuous, grayish-brown species. The larvæ bore in the direction of the tree, and when mature, gnaw a transverse groove in the solid wood, leaving only the thin outer bark intact. They then retire backward an inch or more, filling up the space in front of them with their chips, The winds soon break off the nearly severed branches, and the ground in wood lots is often strewn with them, each of which, if cut open, early in the spring, will be found to contain either grub or pupa.

Another very singular insect of this family is the Twig Girdler (*Oncideres Cin-*

gulatus.) It deposits its eggs, singly, in the small branches of hickory, persimmon, crab apple and other trees, both wild and cultured; and after having done so, completely girdles the twig at a short distance below. This procedure is prompted by the instinct of the parent beetle to provide her progeny with dead but still fresh wood for their subsistence.

The elm, the beech, the prickly ash, the pine and other trees have their own particular borers among the Longicornes, as well as some which they share in common. But the enumeration and description of the various species would extend this paper beyond all reasonable limits. I will therefore conclude with a few words on the vitally interesting subject of remedies or preventives.

As far as the forests are concerned, man is utterly powerless against these lilliputian foes. He must leave all to nature, who, fortunately, take scare to prevent the extinction of one indigenous species, be it plant or animal, by another. Our forests are not, consequently, entirely abandoned to the unchecked ravages of the insects just enumerated. Undue multiplication is measurably prevented by parasitism. The parasitic species are mostly four-winged flies, belonging to the family *Ichneumonidæ*. These flies are endowed with a subtle perceptive faculty by which they are enabled to determine the exact location of the hidden borer, and by means of their long ovipositors they pierce to its retreat and consign their eggs to its body. From these eggs hatch maggot-like larvæ before whose voracity the grub soon falls a victim.

Besides the enemies of their own class a vast number of boring larvæ are annually destroyed by birds. We little know to what extent we are indebted to these feathered minstrels for comfort and æsthetic enjoyment we derive from trees. They not only destroy myriads of caterpillars and leaf-rollers that devour the foliage, but a large number prey habitually on the boring grubbs. Some of them like the little Nutchaches (*Sittidae*), Creepers (*Certheriidae*), and a few of the Warblers, particularly the little black and white Creeping Warbler (*Muiotilla varius*), are constantly running up and down the trunks and larger branches of trees, peering with their little bright eyes into every crack and under every scale of the bark in search of the insects that commonly lurk there. The Woodpecker also, especially the Red-headed Woodpecker (*Melanerpes erythrocephalus*), and the Flicker (*Colaptes auratus*), are valuable conservators of trees. They perceive and follow up the traces of a borer with undeviating accuracy, nor cease their drilling until it is disclosed. Even the much maligned Sapsucker (*Sphyrapicus varius*) probably does more good than harm. At least he is rarely found to attack perfectly sound trees.

Forest trees, standing separate around our dwellings, may be protected in great measure from the attack of borers by having the trunks occasionally rubbed over with common brown soap or washed with soft soapsuds. This substance seems to be distasteful to the beetles, and they will not lay their eggs on bark where it has been recently applied. If such trees are carefully watched the presence of a borer is readily detected by its sawdust-like cuttings, and it may be killed by probing the channel with a wire.

FOREIGN CORRESPONDENCE.

SCIENCE LETTER.

PARIS, April 13.

We are commencing to know something more reliable about infusoria in their relation with life and disease, and an immediate future reserves us some important discoveries. Ferments are petty organisms acting upon fermentable matter, and requiring oxygen for their development, since carbonic acid suspends their vitality. These animalcules, or vibrions, are peculiar to, and vary with certain diseases; thus the mange or scab is produced by the acarus, a kind of tick or mite, and so small, as their name indicates, as to affix themselves on other insects; they have been even found in the human eye and brain. The trichina is a vibrion peculiar to a malady affecting pigs, and anthrax or carbuncle is produced from animalcules called bacterides. By inoculating an animal with these bacterides or their germs, the malady is produced with a frightful rapidity. M. Pasteur, whose experiments on fermentation are so well known, lately deposited three hens on the table of the Academy of Science; one was dead, the others living. Ordinary animals when inoculated with a few drops of a liquid containing bacterides of carbuncle or *charbon*, die in a few days. But all the efforts of M. Pasteur were wholly unavailing to poison the blood of cocks and hens. Why? Birds have a higher temperature than other warm-blooded animals. Now the temperature of the body of animals that become affected by carbuncle, ranges from 95° to 102°, while the blood of domestic fowls is as high as 107° and 109°. M. Pasteur inoculated some hens with the carbuncle animalcules, but without result; next he reduced the temperature of the bird, by plunging it in water, then introduced the virus into its system, and after twenty-nine hours it died. Birds that were inoculated with the same virus, and at the same time, but retaining their natural temperature, escaped. A post mortem examination showed that the bird's blood was a mass of bacterides, and hence poisoned. At the same moment a third bird was also dipped in a cold bath—which did it no harm—to show that the proceeding could not have caused death. M. Pasteur has already demonstrated, that a temperature of 111° prevents the bacterides in course of reproduction from developing, and hence, in the case of birds, remain inert in their blood. He is now testing, if, after inoculating fowl at a low temperature, raising the latter will destroy the virus. Claude Bernard has demonstrated, mammiferous animals died when their temperature exceeded 113°. These experiments will have the most important bearing on the treatment of zymotic diseases which create such havoc in populous localities.

The Academy of Science has never been able to discern its Manni prize, for the best means of quickly and unmistakably recognizing, when a person is dead,

in order to prevent precipitate burial, of which the present Cardinal Archbishop of Bordeaux, among other instances, was all but the victim. Competition has narrowed the question but not solved it. In the present state of the inquiry, real death is recognized by the absence of heart beatings, as determined by auscultation, rigidity, insensibility of the muscles to electricity, and incipient decomposition. Excepting the latter, the other signs are not reliable. Of late the formation of a black or brown spot on the white of the eye, in shape round, oval or triangular, has been admitted as a test, and Drs. Garibaldi and de Lacharriere accept it as a "contributive proof" of death. This spot generally precedes by twelve hours the rigidity of the body. Decomposition often sets in very slowly, hence why in parts of Germany the dead are temporarily placed in a special house, coffins opened, and a bell rope near the hand of the occupant to summon the guardian in case of resuscitation.

No chemical question has been so much debated as that respecting the nature of the acid in the gastric juice; was it lactic or chlorhydric? M. Richet has determined that, in its fresh state, the gastric juice contains volactic acid; that this latter is only formed after a certain time, and appears to be a product of decomposition; this was peculiarly evident in studying the gastric juice of fish—the skate especially. Be the acid what it may, its presence is essential in order that the gastric juice can dissolve certain alimentary principles, the pepsine, or digestive element, losing its dissolving power in an alkaline medium, or one weakly acid, or neutral.

M. Faye has ventilated his theory on the formation of tempests. In all streams and rivers, one can perceive certain eddies, due to the difference in the rapidity of circulation of the tiny currents whose aggregate constitutes the mass of liquid. These whirlpools seem to move round a vertical axis, forming an inverted extinguisher. Swimmers know how dangerous are these eddies, which suck down all objects, and after transporting them to a certain distance throw them up to the surface. Similar phenomena occur in the air, where certain currents known to exist, are taken advantage of by aeronants. Now every current necessarily supposes a difference in the velocity of the fluid parts which compose it; their inequalities produce aerial eddies, known as tempests. The latter, following M. Faye, are simply whirlpools, with a vertical axis, describing curves almost as regular and geometrical as the stars in their orbits. Produced in the upper currents of atmosphere, tempests move in curves from the equator toward the poles, and in both atmospheres their march can be determined in advance. Originating near the equator, storms move toward the West, then incline Northward, and finally take an Eastern direction. Arago was the first to suggest the practical utility of these facts. M. Faye observes that were the Mauritius connected with the island of Reunion, by means of a cable, ships at anchor in the road of the latter could learn the certain approach of a storm from two to four days in advance. At the commencement of their circuit, tempests travel with comparative slowness—hence their coming can be heralded—increasing in rapidity

as they advance; they begin at the rate of a goods train often, and too frequently terminate like a "lightning express." M. Faye repeats that the Gulf stream exercises no influence on the march of storms.

The same gentleman denies that the planet Jupiter exercises any influence on the smallness or largeness of the sun's spots, because the duration and variations in size of the latter coincide with Jupiter's year, equal to nearly twelve of ours. M. Cornu is of opinion that the action of the sun, on the phenomena of terrestrial magnetism, may be due to the enormous masses of iron vapor contained in the external, gaseous strata, surrounding the sun. This might explain the diurnal variations of the magnetic needle, corresponding with the sun's positions, as geographical changes depend on differences of latitude. The same gentleman further thinks that iron forms an important part of all planetary bodies, bounding his conclusion on the fact that the mean density of our globe is a little more than double the mean density of the bodies which compose it; that its central mass is constituted of matters denser than the rocks on its surface— of metallic substances and most probably iron. The idea of Laplace was, that all planets were formed from a common cosmic matter.

Since 1859 there have been found mixed up with atmospheric dust, globules of magnetic iron, resembling those common spherical atomies of iron obtained on striking a common flint with steel, or that can be gathered in the interstices of paving stones over which horses have trotted. Messrs. Tissandier and Meunier have detected these microscopic spheres of iron in rain water and in air—dust gathered in the Alps. The minute particles of iron disseminated on the crust of meteoric stones present nearly an identical shape with those obtained by Tissandier. Are these particles of iron of terrestrial or extra-terrestrial origin wafted from forges by the winds? This peculiar iron-dust has been found in the Southern hemisphere by Admiral Serres in the depths of the ocean, profoundly imbedded in sand or mud. Nay, more, they have been discovered in geological strata anterior to the appearance of man on our planet; they have been detected in the earth excavated in the artesian wells of Paris, one-third of a mile below the surface. Now as these spherical atoms, gathered in divers latitudes and depths, are ever magnetic, Tissandier concludes, they are the result of iron dust, constantly dropping on the earth, and since time immemorial, from those extra-terrestrial sources—meteorolites.

M. de Baisbandran discovered two years ago the new metal *gallium*—which he found strangely enough before having seen it, by means of the spectrum analysis, in a piece of mineral; the metal by this analysis revealed rays not corresponding with those of any known metal. It is more valuable than gold, but as it melts in the hand, it is never likely to become a useful, though not the less remaining a precious metal. After enormous difficulty nearly four and a half tons of blende had to be fused, and the mass after further reductions treated by reagents to produce only two and a quarter ounces of *gallium!*

Although Boyle, from the year 1670, showed that air was necessary for the life of all animals, it was only at the commencement of the present century that Spallanzani demonstrated the identity of the process of respiration with all animals. Fish placed in free air absorbed oxygen and gave off carbonic acid; also when a stratum of oxygen was placed on the surface of water in which tench lived, the oxygen was absorbed and carbonic acid eliminated. But what ratio of oxygen disappeared thus in combination with fish? The latter take their supply o oxygen in a state of dissolution, while animals that live in the air absorb it in a state of gas. But here all identity ceases, for Messrs. Jolyyet and Regnard have just shown that aquatic animals never emit more of carbonic acid than they absorb of oxygen, and that with respect to the absorption and giving off of nitrogen, no result has been ascertained.

The average consumption of meat per individual in France per year is sixty-two pounds, and the price for the best morsels of beef is 2.50 fr. per pound. The engineers of the Paris and Rouen railway attest that when the navvies replaced their ordinary diet of bread, soups and vegetables with that of solid beef, the quantity of work they performed was increased three-fold. Vital statistics prove in the case of the cities of Lisle and Rouen, when the consumption of meat diminished, there was an increase in the death rate, and when the consumption augmented not only did the contrary result ensue, but a large addition was made to the births. The French do not care much for Liebig's extract or the Appert process of preparing meat; they want the latter natural and fresh. It is then with regret that the Tellier plan of preserving meat on board ship, by artificially prepared cold has failed, but more in a commercial than in a scientific sense.

Professor Bouchardat counsels those who eat pounded raw meat to be certain they purchase from a butcher who deals at the official *abattoir*, as much of the beef slaughtered in the provinces is diseased and is so delivered in Paris for sale, producing fatal consequences; in the handling of such meat in the market the porters have contracted malignant pustules. M. Mezrin draws attention to the breaking out in the artillery regiment to which he is attached, of the tape worm, in consequence of men eating measly bacon. May this not explain the prevalence of the same malady, which resembles a chronic epidemic, among the working classes of the city?

Dr. Legendre considers that scrofula and consumption are sisters, only different manifestations of the same causes. Velpeau was accustomed to say, "when you wish you can render a child scrofulous;" he meant by depriving it of the proper conditions of healthy life. Putting aside antecedents of parents, Dr. Legendre asserts that no treatment of scrofula can be effective, which has not for its base hygienic principles, and that these can be best practised by a residence at the sea-side; he further states from a long experience that the children of the poor are more speedily cured than those of the rich.

On the opening of the Exhibition the recently built Avenue del' Opera will

be lighted with electricity instead of gas, and colored dim globes will be employed to soften the effulgency. There is one draw back still to the new system, the necessity of having relays of machines to produce the currents. For a distance of one thousand yards three machines at least will be required to generate the fluid. Even this defect Jablochkoff expects to correct. M. d' Arsouval announces that he finds the telephone to be more sensitive than the nerve of a frog to electricity. F. C.

HOME CORRESPONDENCE.

PLEASANT HILL, MO., April 27, 1878.

MR. T. S. CASE,

Dear Sir:—Please give the following a place in the pages of your next monthly:

April 18.—At 7:50 P. M. a meteor was observed to pass from near Theta Tauri toward a point beneath the Pleiades. Its trail was 5° to 10° in length, appearing only a second, then vanished.

April 20.—At 8:45 P. M. a meteor passed rapidly like a bright streak, 15° to 20° in length, Southeastwardly, between Taurus and Gemini, was visible two seconds. Clouds passing over immediately prevented its correct position being noticed.

April 24.—At 9:45 P. M. a meteor passed Northwardly between Bootes and Ursa Major with a path like a streak quickly drawn, and about 25° in length; apparently emanating from the Northern crown—visible two seconds.

April 26.—At 9 P. M. a meteor passed Southeast from the Northern crown. Train a quick streak about 10° long and visible a second.

You can also add to list of minerals found in Stony Meteorites, two in addition to those I named in my article in Number twelve of Volume one of your Journal. They are Lawrencite, named after Prof. J. Lawrence Smith, and Daubrielite, described in 1876 by Prof. J. Lawrence Smith and named after M. Daubrie, of France. The composition of the latter is: Sulphur, 37.62; Chrome, 62.38. These elements are proven by the spectroscope to be contained in the vapors surrounding the sun and therefore must be extensively diffused in the universe.

G. C. BROADHEAD.

The southern heavens presented a beautiful sight to those who chanced to be looking that way at half-past ten o'clock last night, May 4. A meteor was seen moving at a comparatively slow rate in a southeasterly direction, growing brighter, then dim again, then brightening, until it lighted the entire city. Large burning masses of the main body of the ærolite were thrown off, making the display interesting in the extreme. Persons who saw it pronounced it a phenomenon both strange and grand.—*K. C. Journal.*

MINERALOGY.

THE SILVER QUESTION GEOLOGICALLY CONSIDERED.

PROF. N. S. SHALER.

Many questions of a social nature can be fairly claimed by the geologist as coming within his domain, but of them all none are so bound up with his problems as those that concern the currency. * * * *

Before the geologist can answer the question as to the probable yield of gold and silver in future, he must make clear to the inquirer the general character of the laws that regulate the distribution of metals in the earth's crust, and their gathering into the lodes, veins, beds, and other places of deposit.

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The popular view of the origin of gold and silver deposits is that these substances are derived from the deeper stores of the heated interior of the earth, and that they have been sublimated thence and borne up into the overlying rocks; recent observations have materially modified this view. It is now believed that all the metals are contained in sea-water, and have been present in such waters ever since the oceans came down upon the lands. It is furthermore believed that these substances come into the sea-water by the same processes which bring common salt into the sea, namely, by the leaching of the land by the rain-water, which, armed with the carbonic acid gas given it by the decaying vegetable matter of the soil, is able to seize a part of almost all the substances it finds in the soil or in the rocks, through which it penetrates, and bear its waste away to the deep in the condition of complete solution, as sugar is dissolved in water. In this state gravitation has no hold upon the dissolved metals, and the particles of gold or silver washed away from the rocks of any district may be scattered by the ocean currents to the most remote waters of the globe. In the sea lives a vast variety of vegetable life; each of these species, after the law of its kind, takes from the sea-water a share of the various dissolved matters which it holds, just as the plants of the land take various substances from the decaying rocks that constitute the soil. Certain sea-weeds take up more of one substance, and others another; dying where they grow and succeeded by their kind, they gradually build a rock composed in the main of the substances which they have separated from the sea-water. Some weeds, as for instance the Sargassum, grow afloat in the water and sweep with the ocean stream into great eddies, such as the Sea of Sargasso, and then slowly rot and sink to the sea floor. Some animals, feeding on particular species of marine plants, take to themselves in this way peculiar substances, and when they possess particular parts of the sea floor they too help to build up rocks rich in certain substances.

In time these beds, laid down by particular animals and plants in the slow

events of life and death, become buried beneath thousands of feet of subsequent deposits. We then come to the last stage of the processes of making a mineral vein. The rocks becoming heated by means of the internal fires of the earth, the beds above serve as a blanket to confine the heat that is always escaping from the earth. These heated rocks are now traversed by hot waters, whose movement is, in part, impelled by the heat itself; these waters creep through the closest knit rocks, bringing about manifold changes in them. As they go downwards, the waters are continually taking more and more heat from the rocks; and each increase of heat makes it possible for the water to seize on more of the various substances contained in the rocks. When its course is turned upwards towards the surface of the earth, the water begins to cool; in its slow passage through the narrow avenues of the veins in the rocks, it begins to lay down the substances it has taken up in the lower parts of its course. Although heated water will take up a number of substances while it is at a given temperature, it will lay them down in a successive order as it cools, so that it tends to assort them as it leaves them in its course towards the surface. This brings the various materials into the grouped order in which we find them in veins and other deposits. With a brevity that leaves much that it would be desirable to say unsaid, this is an account of the way in which veins are now believed to be formed. It is easily seen that here, as in all other earthly successions, substances tread an eternal circle in the guidance of water and by the impulse of heat. Through water impelled by solar force the metal is worked out of the crumbling rocks and borne to the sea; by organic life, itself the creation of solar force, it is borne back to the rocks; thence, in time, it is to be taken once again upon its ceaseless journeys.

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The process of change that brings the dissolved silver of the sea-water into the deposits of the rocks, where we find it, is without doubt essentially the same as in the case of gold. There is, however, this peculiarity about silver: it is very frequently associated in considerable quantities with lead and with copper; in its association with the former metal it is often found deposited in districts where the evidence goes to show that the deposits have not required the intervention of highly-heated waters. The conditions favoring its occurrence in forms suitable for the miner's needs came about much more often in the workings of our earth's laboratories than in the case of gold. The result is that the area over which silver may be profitably sought is much greater than that over which gold may be searched for to advantage. In Europe, Norway, Saxony, Bohemia, Austria, Hungary, and Spain, have continued the production of silver for centuries with a steadiness not equaled in any other mining industries. In the Peruvian and Bolivian districts of South America the yield has had something of the paroxysmal character common to all gold districts, but this irregularity is apparently due as much to bad government as to any irregularity in the supply. Chili, where the government has been reasonably good, maintains a steadily increasing outpour of silver. There can be no doubt that in the future production of this metal the mines of the Andean district will be among the largest contributors.

Mexico and the extension of the Cordilleras to the north and within the United States partake in the abundance of silver which seems given to the Pacific coast of the Americas in a singularly great share. By far the larger part of the silver furnished to the markets of the world has been from this great mountain chain. In three centuries the Potosi mines alone yielded over twelve hundred millions of dollars' worth of silver; and in the same time the Mexican mines poured out about twice this quantity. The other mines in this Cordilleran chain have brought up the sum somewhere near five thousand millions of dollars. The American continents are, it would seem, proportionately more richly stored with the ores of silver than those of any other metal.

Besides the silver-bearing beds which are rich enough in silver to deserve the name of silver mines, there are many mines, which are mainly worked for other metals, that still furnish considerable amounts of silver; most lead-bearing ores yield a quantity of silver that pays for the additional labor required to win it from its combinations; the same may be said of copper ores. Although these sources of supply are but moderate, they are constant, and in so far act to secure that steady production of the metal which is of the first importance to its use as a standard of value.

The relatively ready oxidization of silver, its relative lightness, and its unfrequent occurrence in disseminated grains account for the important fact that it is never found in river deposits or other places where it can be readily won by the miner. Furthermore, only a small part of the deposits that can be drawn upon in case of need have yet contributed to the supply of the world. Silver mining in Asia, Africa, and Australia can hardly be said to exist. There are, doubtless, very many sources of supply yet untouched, as before noted. Most gold districts are first explored for gold which is scattered through their river sands; it is only at a later state of the prospecting that miners seek the lodes whence, by the wear of the surface, the scattered gold has been obtained. There are no such natural guides to silver deposits as there are to those of gold. It is only by rare accidents or careful prospecting that deposits of this description are found. It follows from these diverse conditions of occurrence of gold and silver that the former metal must be produced with far less steadiness than the latter.

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Silver gives a promise of steady yield in the future which is not afforded by gold. The sudden acceleration of production during the last few years, due in the main to the marvelous and unexampled extension of mining industry to the vast metalliferous region of the Cordilleras of North America, great though it has been, is not, considering the volume of silver, proportionately as disturbing in its effects as the inundations of gold from California, Nevada, and Australia have been. The Comstock lode is the accident of a century. Except for it the silver production of the Americas has had a singular steadiness during the last fifty years.

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There is no evident reason why within a few years the production of silver should not again fall to its average rate. Owing to the extensive demand for silver in Asia, its rapid wear and its great use in table furniture, a very few years

will fast drain away the existing surplus when the Nevada supply is withdrawn. Over a hundred years passed between the culmination of the silver production at Potosi and the period of greatest production in Mexico, and over fifty years between the time when the latter began rapidly to decline and the beginning of the prosperous days of the Nevada and Colorado silver mines. Each year makes it less and less probable that the world is to see new discoveries leading to such sudden movements of production. All the indications point to the steady yield of silver and to the unsteady yield of gold in the century to come.—*Atlantic Monthly.*

MISSOURI MINERAL PRODUCTION.

The Pig-Lead Association ascribes the greater firmness of the market to its combination. Its organization is not yet perfected and probably never will be, but it embraces our most prominent shippers. The "estimable gentlemen" composing the association claim to be better informed about the capacity of their mines, under existing circumstances, than those who are outside of the P. L. A. and not engaged in mining; they argue from the *Journal's* own reports from Utah that, unless lead advances, that State will not be able to continue its enormous shipments; that it will be time enough to consider the importance of similar shipments from Colorado when they come to market. In the meantime they aim to prevent a further decline by holding, and assisting others to hold, their lead. Fully aware of the probability that the production of lead in the United States may in the future far exceed the consumption, they still assert that at present the production does not exceed the demands of the country when in a healthy normal condition.

To meet the emergency, when it shall become necessary, the utmost efforts are now being made to establish the most rigid economy in the management of mines and the utilization of ores. Dressing works are largely introduced where ever veins or beds of sufficient extent warrant it. The total production of lead in Missouri is one-third below the late average. The new mines of Short Creek, Kan., diminish the deficit to one-fourth and may possibly cover the whole deficit by July or August next.

Short Creek has become the great attraction of the Southwest. Immense beds of mixed galena and blende in flint have been struck and are now profitably mined from twelve to fifty feet beneath the surface.

The countless clay diggings—that is, diggings in the red clay overlying the encrinal, second and third magnesian limestones of Missouri—find difficulty in making both ends meet, having hitherto only succeeded in making one end meet. The depreciation of lands of this nature is astonishing. One tract which sold a few years ago for $100,000 was recently disposed of for $16,000.

On the other hand, I notice with admiration the efforts of the proprietors of more permanent deposits to prepare for the coming struggle with the far west mines. The utmost efforts are being made to retain the reputation of Missouri

Lead, Tally No. 1. Short Creek, with its enormous deposits of lead and zinc at shallow depth, will easily hold its ground. Joplin, Webb, Oronogo, St. Joe and Desloges are ready for the war. Mine La Motte and Granby could, but for certain reasons will not. Necessity will teach them how to avoid the depreciation of valuable mining property.

The "Mining Items" of the *Journal* contained a notice of the Einstein silver mines near Fredericktown, Southeast Missouri. From Mr. Setz, assayer at Mine La Motte, I learn to-day that an average specimen, assayed by him, contained twenty-three ounces of silver. I vouch for the veracity of Mr. Setz.

The mining of zinc ore continues prosperous. The strong competition of Illinois, Kansas and Missouri smelters keeps the market very brisk for blende, which is preferred on account of its large percentage of metal. The erection of dressing works utilizing much of what has hitherto been considered unprofitable to dress, adds largely to the production.

The market for silicates and carbonates is very dull. The shipping of two-thirds of waste which accompanies these raw ores is an absurdity. Large profits can be realized by contracting for these ores and the building of furnaces at the coal mines in the vicinity of such deposits.

The iron mines and furnaces of Missouri are sleeping; only one furnace of the Missouri Iron Company, furnished with Iron Mountain ore, is in operation. South St. Louis, a few years ago the little Pittsburg of St. Louis, is as silent as a graveyard. Millions invested are locked up and moldering.

Most of our iron mines appear to be unable to compete, at the present state of the market and the limited demand, with other States where the proprietors have the advantages of coal and iron near together. It is claimed that the Iron Mountain Company could, if it would, thereby securing a partial revival of the great iron business of South St. Louis. Between that company and the Iron Mountain Railroad Company, lively letters have been exchanged in the St. Louis papers. As it is a subject of great importance, I shall try to obtain a clear insight into the matter, but how the Iron Mountain Company can possibly be induced to sell its iron for the benefit of St. Louis, if its own counsels do not tell it to do so voluntarily, is another question. The Iron Mountain Company is one of the wealthiest in the State, and its members are generally enterprising enough where they can see large profits. Millionaires, as a rule, are not expected to become patriotic until after death.

The white lead manufacturers of St. Louis protest against the charge of pig lead producers, that the white lead manufacturers had combined to depress the pig lead market. Mr. Thompson, the President of the White Lead Association, assured me that at the meetings of the association such movement had never heen thought of, as it would naturally have led to a depreciation of their large stocks of pig lead, which their business compels them to carry under all circumstances. Large purchases had been made by them when pig lead was quoted 5½ and 5 cents, and they certainly would not have done so if they had believed the price could be lowered still further.

Mr. Thompson has just returned from a trip to the chief white lead works of the country, and informs me that the proportional sale of white lead in 1877 has been 50 per cent. only of that of 1876.

The manufacturers of spelter complain about the same dullness of the market. Like the white lead manufacturers, their works, once started, are kept running like a runaway horse, with profit or no profit at the end of the race. One is hopeful, the other discouraged, the third wants to sell—but still they all keep running.

The only establishment for the manufacture of zinc oxide and barytes in St. Louis reports a large decrease of trade. Its ores are received from Southeast Missouri and Kentucky.—*Correspondence of the Engineering and Mining Journal.*

ARCHÆOLOGY.

NEW MOUND DISCOVERIES.

BY C. W. STEVENSON, STATE NORMAL SCHOOL, WARRENSBURG, MO.

Art is a temple, whose blazoned walls, written o'er with the histories of nations, give forth a steady gleam upon time, and upon whose shrine are placed the classic gifts of the Immortals. No better history of the acts, no better index to the character of a people can be found than that written so indelibly in their art productious. By art, the ideas and imaginings, the desires and caprices, as well as the accomplishments of a people are treasured up and fixed forever on the monument, the engraving, the painting and the statue. "The beings of the mind are *not* of clay—" they are "essentially immortal" and when they are imprinted upon adamantine rock, they are "immortal" to the world. Here do we find the finer feelings, the beauteous conceptions, cast, it may be, in the form of a mythical religion whose poetry only heightens their color, portrayed to us forever. And this is why we cherish every art production, as we would cherish the memories of the very hearts' desires, of those who have lived and struggled before, and by whose civilization we attain our present grandeur.

To the American it is especially interesting to study the art relics of that people, who, in centuries past, tilled the same lands and drank of the same mighty streams as he does to-day. The history of that people, upon whose civilization the same beneficent sun shone as it shines to-day upon his own enlightenment and comfort, must stir the finer feelings of his nature, while he must look with no little admiration upon the antique and beautiful ruins of Mexico and Peru. These ruins, crumbling with age and breathing forth the most delicate odors of fable and myth, found in a land, where may be seen in picturesque contrast the lurid flames of the volcano, the gleaming mountain capped with eternal snow, and the richly dyed blooms of the tropic, must remind him of the pictured land of Granada and the marbled halls of the Alhambra. Every relic of a peo-

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ple once so enlightened, and possessing the refined feelings of to-day, must excite especial interest.

And while we are treasuring each relic of this departed race, with what feelings must we look at the Spaniards! No people in the world have destroyed the art-products of peoples with as ruthless hands as these Spaniards. Hardly had they conquered the Moors, turned their beautiful fountains, playing in music among groves of olive and pomegranate, into broken statues and stagnant pools, when they began to glut their greedy souls upon the riches of Anahuac, and, under the garb of religion to commit outrages and desolation unparalleled in history. The very scarcity of any traces of the people who once inhabited America increases an interest in finding those things which the imagination already pictures.

In the vicinity of Warrensburg, a few months ago were found remains, in the shape of tomb-mounds, of what we believe to be this famous people. The papers of the city teemed with sensational stories—fitted peculiarly to excite a morbid curiosity, and the consequence is that many mounds, rich, no doubt, in concealed history, have been worked with no system and only a few relics unearthed. These, however, as we shall show further on, are enough to establish the antiquity and civilization of the people.

Every mound excavated so far discloses the stone box within, forming the true cist. The walls of this box are made of flat stones, with no cement between, presenting an appearance very like the oldest form of cyclopean masonry in Greece. They are all essentially the same, their dimensions being nine feet in width, eleventh in length and six in depth.

We should state that these are the measurements of the box, the mound itself being about fifty feet in circumference at the base and ten in height. These mounds have been attributed to the work of the North American Indians by some, though this box within must entirely disprove such a statement. The Indians never buried in stone boxes erected for the purpose, and their defences wherever found, consist, in almost every case, of earth-works, stone being used very little. We cannot trace these mounds to the North American Indian and hence must give to them a greater antiquity.

If we divide the ancient history of America into two epochs, excluding the time when man co-existed with the animals, one commencing a few centuries before the advent of the Europeans, and extending to a time when the United States was settled along its whole eastern coast, the other embracing the time previous to this, we must place these mounds in this last named epoch giving to them a great antiquity and putting them beyond the pale of the most ancient Indian. For we know that the Indian was taken from the Stone age directly into the Iron and hence has no Bronze implements of his own construction. In the mounds found, are relics of the bronze age as we will see further on. We may name then the first epoch the mound epoch, and the last the historic epoch. From the many excavations in the different parts of the United States, it is determined that there are three classes of mounds, first, tomb mounds, second, sacrificial mounds, third, mounds for temples and palaces; the finding of bones in a state

of great decay, with some in perfect preservation, the former below, the latter above, and other attending circumstances, show that the original occupants of the mounds are very old, and that the Indians have also used the mounds as places of sepulture. Again, at the time the Europeans came into the country, the copper mines of Lake Superior were not known to the surrounding Indians, and hence we conclude, if the tradition of their being worked had faded from the minds of the conquering race, that the mines were worked by the most ancient of the mound builders, and in their mounds only will we find copper. In the mounds excavated in this vicinity, we find a piece of pottery having around it a copper band, establishing their very great antiquity.

Having established the antiquity and origin of these mounds, we need only mention other facts which tend to show that they do not belong to the Indians. The Indians were in every way inferior to the mound builders in art capabilities. In their burial places stone axes and hatchets are found; pipes, bowl and stem in separate pieces, made of red stone of the West, are peculiar to their burial places. Everything found in the mounds tends to show an advanced state of civilization and high art power.

Let us next consider some of the relics found in these mounds, and by comparison with the history of other excavations and also traditional history, find the character of this people and who they were. The least important of the relics are arrow heads found in all the mounds in abundance. These were taken by some as evidence of Indians, but erroneously, for it is known that the conquerors found them in use among the Aztecs, even the monarch Montezuma carrying a sword whose edge was of obsidian, and wielding a stone battle axe.

In one of the mounds a curious piece of mineral was found. It is covered with a reddish coating of oxide showing it to be red hematite and is so nearly pure iron as to lead one to believe the mound builders knew a rude method of smelting the ore. Another peculiarity of this small bit is, that from its shape one would say that it was a corner from a slab about ¾ of an inch thick. It is hardly probable that the people who buried in these mounds knew anything of the metal iron, for it requires an intense heat to smelt the ore, which must in all cases be obtained by mining.

A small piece of bone and a similar piece of flint, both circular, with the inside smooth, the outside polished and colored, were found, showing that a very delicate piece of work can be done without the use of bronze implements. These two specimens very likely formed the ruins of some vessel of so delicate a make up as to succumb to time.

Plates of mica have been unearthed, discolored with clay and so disconnected from all else as to leave their use only a matter of conjecture.

A very interesting specimen and one which bears largely upon the history of this people, is a large conch shell, nine inches in diameter, and eleven inches long. Whether the mound builders knew its use as a winding horn, or whether its fantastic shape and colors attracted their attention to it as a plaything or ornament, is immaterial, its presence in the mound establishes the fact of the migratory

character of the people. It must have come from the sea shore, probably from the eastern, as will be shown further on.

One of the important relics, is made of greenish-blue slate, and is what is known as a "skinning knife" or "scraper," the grooves running across it in various directions showing a rude attempt at ornamentation, while the hole drilled through it shows its means of attachment to the person. The "knife," as its name indicates, was used for skinning animals and for this purpose one of its edges is beveled or sharpened, the fine lines upon its surface showing contact with sandstone. Another use may have been in scraping the hides. What the ornamentation was to picture is mythical, though a decidedly strong imagination can form the imperfect outline of a head for either a bird or seal.

Another remarkable instrument found is a circular disc of a peculiarly fine grained stone with a groove around the edge, and a partial perforation at the center. It is 2¾ inches in diameter and one inch thick. The stone of which this implement is made is rather soft and contains much lime. We learn from accounts of excavations other than this we are attempting to describe, that in most cases these stones, used for drilling, resembling the jewelers tool of to-day, were hollow discs in which were inserted "bores" made of a species of cane growing in the southern part of the continent. How the hole in the disc was made for the reception of the "bore" is a mystery. The fine polish given to the disc indicates the laborious use of sand and water.

We next have a relic which is characteristic of the mound builders and establishes beyond a doubt that the remains found do not belong to the North American Indian. These "pipes" are often made of the very hardest stone and are found all over the Western States wherever mounds of this character are located. The stem and bowl are always in one piece, the bowl being often sculptured in the "mound-pipes," while the pipes of the Indian are plain, the bowl and stem being separate pieces.

The mound pipe found has a plain bowl, and is of the ordinary character of such pipes. The manufacture of these pipes must have been no small work, for we know that the people were ignorant, in the time of the present mound making, of the use of bronze implements, for none whatever are found. Perforations were often made in the stem, showing that the one found in the mounds under consideration was of an early date.

The only specimen of pottery recovered is a jar or urn, which will hold about three quarts, and is of rude construction, made of clay mixed with sand. Around the rim is a meagre attempt at ornamentation, while immediately below this is a band of thin, beaten copper. Below this around the bowl of the jar is a band of silver, also beaten very thin. The pottery of the mound builders shows simplicity and was made around baskets of wicker work or pumpkins. That of the North American Indian took on more fantastic shapes, and was very hideously and profusely ornamented.

The specimens described heretofore trace for us an almost complete history of the people who buried their dead in the mounds we have been excavating.

So far we have found no sculpturing in the mounds and no bronze implements. This tells us that the people were in the later part of the New Stone age. They were also in the beginning of the Bronze age, for we find that the use of the metals was partially known, as is indicated by the bands of copper and silver upon the jar. The art of glazing the pottery was not known, nor do we find it known at all among mound-builders wherever mounds have been excavated. The use of textile fabrics is indicated by the lines upon the jar, for this rude ornament must have come by direct imitation. The people were peaceful, for no weapons save arrow and spear heads have been found. No agricultural implements of note have been discovered, and the people must have been in the main nomadic in character, depending more upon animal than vegetable food.

But who were these people?

We say these people formed the ancestors of the civilized Aztecs and are either the Chichimecs or Toltecs. "Time which antiquates antiquities and hath an art to make dust of all things," has left a chain of tradition, that, linked with the circumstantial evidences of these mounds points in fixed colors the history of that people who buried their dead over Missouri and her adjoining states.

From Spanish history connected with the conquest, we learn that a people, well instructed in agriculture and many of the useful mechanical arts, and nice workers in the metals, came into Anahuac, the territory of Mexico of to-day, before the close of the seventh century. They came from the North and after about four centuries passed away, giving place to another tribe from the North. These two peoples are respectively the Toltecs and Chichimecs. The migration of the Chichimecs was speedily followed by others from the North, the Aztecs being the last and most important tribe.

The Aztecs after many wanderings, overcoming in the mean time the Toltecs and imbibing all their civilization, noticed, according to this myth of their history, near Lake Mexico in the year 1325, a royal eagle perched upon a prickly pear, a serpent in his talons, and his broad wings opened to the rising sun. The beautiful picture thus presented to their darkened minds was hailed as an auspicious omen, and upon the spot where was seen the king of birds, was laid the site of the future city. From this time art and letters were cultivated and there is enacted that miraculous story of grandeur and civilization equaled only in the legends of romance and mythology.

From direct examination of the works of the mound-builders the oldest and most primitive forms are found in the extreme South of the continent, a fact in direct opposition, it seems, to the tradition existing in the time of the conquerors that the inhabitants of Mexico came from the North.

The theory in regard to the direction of motion of the invaders of Anahuac or Mexico is, and all the excavations tend to substantiate it, that the people who anciently inhabited Mexico *did* come from the South, passing through Mexico into the Valley of the Mississippi. Wandering over this fertile field, then much warmer than now, they penetrated the more northern parts, discovering the Great Lakes and the well-known copper mines of this region. Here they remained for

a time, and were either driven again into the valley by the cold storms of the climate or some invading and stronger people. Thus successive swarms of peaceful people recrossed the Great Monarch and his well watered valleys, finding a final resting place in the fastness of Mexico. The last tribe to leave the mines in the Northeast were tribes afterward known as the Aztecs, who carried with them the highest degree of civilization then reached, shown most clearly by bronze implements. The Aztecs were probably driven from their northern homes by the North American Indian.

In the mounds which we have been describing, we have found no bronze implements, but have found metals beaten into thin plates, as silver and copper, hence we conclude that, as the Toltecs knew the partial use of the metals, but were not in the bronze age wholly, it must have been this people who made the mounds in question upon their return journey to Mexico. This would give to the mounds, according to the tradition heretofore stated, an age of about ten centuries. We cannot presume too much, however, upon the superior knowledge of the Aztec tribes on leaving the Lake Superior regions; all theirs may have been built up after reaching Mexico, though this is hardly probable. In case these mounds *were* made by the Aztecs, their age would be reduced to about six centuries.

This people, then, be they Toltecs or Aztecs, who erected these mounds for their dead, and who possessed the primitive culture shown by these few relics, passed on from these fertile valleys of the Mississippi into the tropical climes of Anahuac, there to enact a storied history made known to the world by the genius of the immortal Prescott. Romance nor fable presents so varied and so brilliant a picture.

Upon their arrival in this land of enchantment, a mighty god Quetzalcoatld, came across the waters in a "Wizard ship made of serpent skins," and taught them agriculture and the further use of the metals, as well as the art of government. The whole land was turned into a beauteous Eden, teeming with delightful grass carpeted groves and the most delicious fruits, while nature adorned herself in varied and fantastic colors.

Here in this Elysium they developed their incongruous religion, associating with pure ideas of the true God the dark rites of human sacrifice. Here, in the blind superstition and fanaticism of their natures they tore the palpitating heart of the victim from his body and in mad frenzy cast it at the feet of their God, afterward spreading the flesh of the human and brother in a feast, teeming with delicious beverages, before his friends, and where this same inhuman sacrifice was performed might be seen the peaceful, pleasant picture of children wreathing the statues of the gods with flowers and feeding the sacred fires. Here mighty temples and palaces arose, covered with the most delicate gold and silver casings, reflecting in all their glory the rays of the awful Sun-god; here poetry, eloquence and the fine arts flourished, lifted their proud forms in grace and beauty when the icy demon-like hand of the Spaniard by one blow effaced people and works forever.

XUM

ARCHÆOLOGY IN CENTRAL AMERICA.

A very interesting consignment of pottery, images and implements recently recovered from the ancient graveyards in Chiriqui, Isthmus of Panama, was received in New York city a few days ago. Several gentlemen, representing the Smithsonian Institute, Washington city, also the Metropolitan Museum of Art, pronounce the collection altogether unique and the finest of its kind extant. All authorities agree that they are the remains of a pre-historic race, but nothing positive can be affirmed as to their exact age. The graveyards from which they are taken cover an extensive range of coast some 300 miles northwesterly from Panama, as described in the correspondence below, some of them covered by an apparently primeval growth of forests, and now for the first time a systematic exploration of the region referred to has been commenced in the interest of science. For years past considerable quantities of gold have been taken from them, in the shape of ornaments, idols, &c., closely resembling objects of a similar character found in Peru, and which are supposed to date from the time of Incas, or a period remoter still. More than ten years ago, Mr. J. M. Merrit, now of Flushing, stated before a meeting of the Ethnological Society that he once had a golden tiger from Chiriqui which weighed fifteen ounces. Dr. E. H. Davis exhibited drawings of a golden toad from the Chiriqui graves which weighed seventeen ounces. In Messrs. Lamson's collection, tigers, toads and nondescript creatures of various sorts, are seen in the form of burnt clay, gaily ornamented with pigments. Articles in sheet gold are occasionally found both in Chiriqui and Peru. A golden shroud found in Arica, Peru, some years ago, weighed eight or nine pounds.

"I had expected ere this to have come to a more definite conclusion as to the age, &c., of a people, the works of whose hands alone remain to tell us that a race, vastly superior in many respects to that found by their Spanish conquerors a few centuries ago, once thickly populated this land, and at so remote a time as to leave a very few traces of organic remains.

The vast area over which these burial grounds are spread, and in many cases so closely occupied, affords evidence that the more elaborately constructed graves or vaults have been used as family sepulchres.

The most definite proof of antiquity I have seen is the numerous stone cutting implements so generally found, with other works of human fabrication, in these graves. Some of these may have been used in sculpturing the highly wrought images found with them.

It is observed that in all the graves which have been worked of late years, mainly for gold, those nearer the center of the group are richer in gold and the character of the implements is superior compared with graves more remote. These burial places are found alike in what appear to be primitive forests, on the highest mountains and open plains. So far as I have seen, and from information gathered, this vast cemetery extends over hundreds of square miles on this coast. Though there are seldom any surface indications to attract the attention of the inexperienced eye, the expert grave diggers, who have been long in the business, are

not long in showing the traveler a *wauca* by any roadside. To ascertain the position a light iron bar is run into the ground from one to four feet. On striking a stone the expert recognizes a peculiar sound, clears the ground and begins the excavation. It often happens that ten or fifteen feet of earth must be removed before the vault is reached. This is covered with large, flat stones, some of them weighing 300 pounds, and of a different character from any found nearer than several days' journey far up the mountain's side. The sides of the vault are formed of large boulders, evidently brought from rivers' beds far distant. Fragments of implements distributed through the top earth affords evidence that the graves have been repeatedly opened for later interments.

In all the groups of graves I have examined the interments were made promiscuously, at much cost of space. Many of the graves most carefully constructed are observed to contain scarcely an implement, while alongside there might be a long, narrow receptacle containing numerous pieces. Among the implements I now send are several curious stools or seats, which the modern inhabitants believe were worn as crowns, under the supposition that they were bestowed by the gods. You will ovserve that very generally the earthen vessels are made with light handles or projections, so that they might be suspended, while other have legs. It is my belief that all the canteras (local name for all these objects), once contained articles of food, as no implements are ever found within them. You will observe that there is every variety of style, varying from the unique to the ridiculous. The gold, in particular, has been wrought into many droll forms, much of it exhibiting no mean artistic skill. This beautiful handiwork of a long forgotten race contrasts strangely with the rude fabrications of those who now inhabit the land."

ASTRONOMY.

THE TRANSIT OF MERCURY.

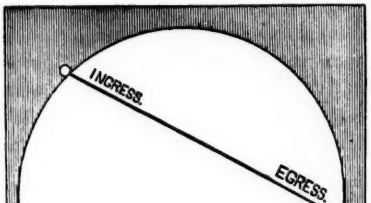
Transits are only possible to us by Venus and Mercury, as among planets discovered these are the only ones with their orbits inside that of the earth. The transits of Venus are very rare. That of 1874 will be succeeded by another in 1882, and this will be the last for more than a hundred years. Those of Mercury are much more frequent, occurring at intervals of 13, 7, 10, 3, 10 and 3 years.

Mercury travels in a very eccentric orbit, his mean distance from the sun being about 35,392,000 miles—his greatest distance is 42,669,000 miles, and his least 28,115,000. When nearest the earth we are within 45,000,000 miles of Mercury, and he goes as far away from us as 135,500,000 miles. From his nearness to the sun Mercury is rarely visible to the naked eye—sometimes immediately after sunset and again shortly before sunrise—the most favorable time for observation being when he is at his greatest elongation, which then places him at at about 85,000,000 miles from us.

The size of Mercury is about 3,000 miles diameter. His mass is denser than that of the Earth, being compared to it as about 10 to 9. He travels round the sun in a little less than three of our months, and his day is about as long as ours.

A transit of Mercury is not so important as that of Venus, because his nearness to the Sun prevents his having a measurable relative parallax. The distance of Venus from the Sun is such that when in transit, seen at the same moment from different points of the Earth's surface, she occupies two spots visibly separated from each other, thus allowing the angle to be measured, by which the Sun's distance from the Earth can be calculated. But Mercury being so close, this is impossible. But these transits are valuable as illustrating the same phenomena which occur in transits of Venus—the black drop, a small black ligament, which at the moment of contact seems to connect the disk of the planet with the dark space outside the solar disk. This in transits of Mercury is very manifest. Other indications observable clearly point to the existence of an atmosphere of considerable depth and density.

The diagram below shows the points of ingress and egress, and is represented as if seen by the naked eye. Seen through a telescope, which reverses the position of an object, of course it would present a different view from this, but as the readers of the Journal will, as a rule, look at it through ordinary glasses, we give the illustration to suit them, as an astronomer who has a telescope needs no information on the subject. To catch a view at the very earliest moment of contact, the eye must be directed to the exact point on the limb of the sun, and everything should be ready at 9 o'clock city time at Kansas City. We are very favorably situated for a view of the entire transit, should the day be clear, as it occupies 7½ hours in passing across the sun.

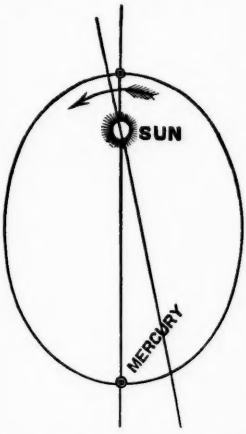


But the special value of this transit to astronomers is the light it may throw on the hypothesis of the existence of a planet with an orbit interior to that of Mercury, predicted by Le Verrier from calculations of the perturbations of Mercury. This great astronomer discovered Neptune in this way, and he died with the full conviction that a planet he had named Vulcan exists between Mercury and the sun. Lescarbault, and Wolf, and Weber, three observers in Europe, claim to have seen such a planet, and so does our weather prophet, Tice, who makes it a very important factor in his forecasts.

Le Verrier discovered perturbations in Mercury, which no known cause could explain, and placing all recorded observations of transits along side his computations, he estimated that the point of Mercury's perihelion moved more rapidly than it should move from the influence of known bodies. The variation

is about thirty-six seconds of an arc in a hundred years, or near one thirtieth part of the angular diameter of the planet in a year. But slight as this is, it is a departure from the law which governs, or seems to govern, the orbits of all the planets.

This diagram shows the exceedingly eccentric orbit of Mercury. The line passing through the sun, from perihelion or nearest point to the sun, to aphelion, or farthest point from the sun, is what is called in astronomy the line of apsides. It is always moving on the sun as a centre from right to left,—the same direction the planet itself is moving,—according to a certain constant of motion. Or the orbit of the planet turns round the sun as does the planet itself, only in a vastly greater period of time—in degree as a cam-wheel turns on its axis placed out of centre. It was the undue velocity of this great cam-wheel of astronomy, which disturbing the movements of the planet and its times of transit, arrested the attention of the great French astronomer and led him to ascribe it to the influence of an unknown and interior planet.



It will be remembered that a year ago, at the instance of Le Verrier, the whole astronomic world was on the *qui vive*, looking for the new planet, but failed to discover anything. In the meantime Le Verrier died, but his theory remains. There are two parties among astronomers on this question—those who favor the theory of the existence of Vulcan, and those who think the calculations of Le Verrier contain an error—or that he was mistaken in his assertion as to the acceleration of the apsides of Mercury. Among the latter is no less eminent an authority than Dr. Peters, who suggests that in making up the difference between computation and observation, Le Verrier had erred in overrating the observations themselves, especially the older ones, as for example, the transits of a hundred years ago. So has M. Liais, of the Brazilian coast survey—both declaring against any variation which required the existence of an interior planet.

It is this disagreement which gives astronomical importance to the transit of Mercury which takes place to-morrow, and it is to be hoped the observers in Missouri and Kansas will be able from our clear skies and favorable conditions to add something to the solution of this very interesting question.

The exact time of ingress is 10.04, Washington time—of egress 5.34, same time. Our readers, by remembering that the earth is 25,000 miles in circumference, and the time a fraction over a thousand miles per hour difference, can make their estimate for their localities close enough for all but strictly astronomical observations, and where these are made they do not depend on newspapers for one. At Kansas City the transit begins, to be exact, at 8 o'clock, 53 minutes and 12 seconds, and ends 4.23.42. The difference in time between Washington and Kansas City is 1 hour, 10 minutes and 18 seconds—fast.—*K. C. Journal of Commerce.*

VARIOUS OBSERVATIONS OF THE TRANSIT.

Those at St. Louis were made by Mr. Pulsifer and Prof. Rees, of Washington University, at the observatory, just back of the residence of the former gentleman, at 1837 Kennett place. Of course, in order to get the observation within the nearest possible second, it was necessary to get the exact position of the point of observation, as well as the exact time at which the observation was made. The exact time was obtained from Washington by the Western Union Telegraph, but time will be taken each day from the 1st to the 10th of May, in order to more accurately compute the time by the chronometer used at the observing station. The more accurately the running of the local chronometer is known, the more valuable, all other things being equal, the result of the observation made by their aid. Hence comparisons of time will be made twice daily, until the 10th, when they will cease. Then, again, as the time signals from Washington are received at the Western Union office down town, and the observing station was at Mr. Pulsifer's, over a mile west of the time-receiving point, it was necessary to know exactly the difference of time between the point down town and the observatory. People very seldom think of this fact, and we often see two clocks, one some miles west of the other, indicating the same time, while the actual discrepancy should be four seconds for every mile of western distance. The difference in time between Washington, at the Naval Observatory, and the Court House dome at St. Louis is 52 m. 33.27 sec. west, or earlier, and the difference in time between the Court House dome and our Washington University is 3.63 seconds, or between Washington City Naval Observatory and our own observatory at Washington University 52 m. 36.9 sec. It remained then to get the exact point of observation to compute the latitude and longitude of Mr. Pulsifer's house, the latitude and longitude of the Court House being known. The observers, therefore, went to the Board of Public Improvements and had a line measured from the Washington University Observatory, perpendicular, to Washington avenue, and a line drawn from the corner of Mississippi avenue and Kennett Place, perpendicular, to the last line. By measuring these lines and knowing the course of the streets, it was calculated that the latitude of Mr. Pulsifer's Observatory was 38° 36 m. 52.8 sec. of arc. Similarly the operators calculated that the observatory on Kennett was west in longitude 2 sec. of time from the University building, which would give it about 6 sec. of time west of the Court House, or an actual longitude of 13° 13 m. 43.5 sec. west of the Washington City meridian.

Accurate time was carried to the Observatory by means of two fine pocket Jurgensen chronometers from the University chronometer and Jaccard's, both of which were compared with Washington City time. The watches finally used in the observation were compared twice on the day of observation, and will be compared daily till the 10th with the Bliss chronometer.

On account of cloudiness at the time, the first contacts were entirely lost, but about four minutes after the time of first contact the clouds broke and the observer was able to see Mercury projected on the sun's disc in very beautiful style. The two last contacts, however, Mr. Pulsifer was able to see very nicely indeed, and

the times of second internal contact and of separation were carefully observed. The time of last internal contact was 4 h. 41 m. 21.25 sec. p. m., and the time of last internal contact or separation was 4 h. 44 m. 17 sec. p. m., giving 2 m. 55.75 sec. as the time occupied by the body of Mercury in passing over the circumference line of the solar disc.

It may here be stated that these figures as to time have to undergo still further comparison and calculation before the full report of the observation will be made to Prof. Newcomb, at the Washington Naval Observatory. It was of course a great disappointment to the St. Louis observers that after days and nights of preparation they should have missed the first two contacts, but the misfortune was unavoidable and could not have been helped.

At Washington University, Prof. C. M. Woodward rigged up the eight-inch Fitz telescope, belonging to the University, at one of the south windows, and was enabled to show to most of the students and teachers of that institution the dark body of the planet traversing the sun's disc in excellent style indeed.

At various points throughout the city smoked glass and field glasses were brought into play, but afforded no result other than the mere sight of a black speck on the sun's face.

According to observations of Prof. Newcomb and assistants, at Washington, the second internal contact of Mercury with the western edge of the sun occurred at 33 minutes 50 seconds past 5 o'clock this afternoon, and the external contact 2 minutes and 50 seconds later. The planet, through a telescope, appeared not larger than a silver 50-cent piece. The gentlemen engaged in the work say there could not have been a better day for observations. Prof. Eastman was at the old telescope at the National Observatory, and Prof. Hall superintended the taking of photographs of passing planets. These photographs were produced by means of horizontal telescope and reflector.

Observations were taken from the United States Observatory at Ogden, Utah, of the transit of Mercury by Prof. Andre and party, French astronomers. The transit commenced at 7:44 a. m., but the sun was obscured by a cloud. The sky cleared about noon. Only three photographs were taken up to 1 p. m., after which time seventy-five photographs were taken to the time of exit, which was at 3:17 p. m. The observations are regarded as satisfactory and successful.

Observations of the transit of Mercury, at Cambridge Observatory, were somewhat interfered with by clouds, but in the afternoon a clear sky afforded a most favorable opportunity for observation. Contact took place several seconds later than 10:26 a. m. The general results are considered quite satisfactory.

Prof. Peters, of Hamilton College, Clinton, made successful observations of the transit of Mercury. Clouds interfered somewhat with the observation of internal contact. Prof. Peters is of opinion he discovered indications of atmosphere on the planet.

Observations for all four contacts of Mercury with the sun were successfully made at the West Point Observatory.

XUM

MEDICINE AND HYGIENE.

PARACELSUS.*

BY DR. H. CARRINGTON BOLTON, OF TRINITY COLLEGE, HARTFORD, CONN.

In the sixteenth century the passion for alchemic labors attained its greatest height; it penetrated all classes of society from the peasant to the King. The humble tradesmen, the well fed and indolent monks, the learned physicians, the overworked and poorly paid soldiers, the unscrupulous and avaricious Princes, Electors and Kings were seized with the fever for sudden riches to be gained by the hermetic art. A belief in the transmutation of metals, the Elixir of Life and the Philosopher's Stone was well nigh universal. Among the number of those who pretended to possess the philosopher's stone and the universal panacea, none were more boastful and vainglorious than the physician Paracelsus.

This extraordinary man was born in 1483, near Zurich, Switzerland. His father was a cultivated physician and by him Paracelsus was instructed in astrology, alchemy and medicine. He also studied with eminent tutors one of whom was a priestly alchemist and reputed adept.

While still young Paracelsus served as a surgeon during the war against the Venetians and against the Dutch. He afterwards set out to travel for the purpose of acquiring information from the medical men of various countries, in accordance with the custom of the time. He also paid special attention to mining, and traveled as far as Russia in search of mines. While on the frontiers of Tartary he was taken prisoner and carried before the sovereign prince of that country. He was subsequently released, but took advantage of his captivity to learn many secrets of his profession. While in the East he visited Constantinople, at that time the headquarters of alchemists, and there learned the secret of the philosophers' stone. Finally he returned to Germany, and having effected some remarkable cures rapidly acquired a great reputation, to increase which he boastfully announced himself capable of curing all diseases by means of the Elixir of Life. Having attained great eminence he was made professor of surgery and medicine at the university of Basle. Here he was a colleague of the famous theologian Erasmus.

Paracelsus' public lectures delivered in German instead of the customary Latin, drew a great crowd of hearers. Some of his lectures are extant and resemble a collection of advertisements of quack medicines. At his opening lecture he caused a fire to be brought in a brazen vessel and casting in sulphur and saltpeter he solemnly burned the writings of Galen and of Avicenna, whose practice then prevailed.

"Know, physicians," he said, "my cap has more learning in it than all your heads; my beard has more experience than whole academies of you; Greeks, Latins, French, Italians, I will be your king."

His opinions of the Galenical physicians were expressed in coarse language, while his praises of those who employed chemical medicines were hardly less

*Extract from a lecture delivered before the Long Island Historical Society, Brooklyn, N. Y., April 23.

notable. "But now seeing idleness is so much in request amongst (Galenical) Physitians, and all labor and study is turned only to insolency, truly I do not wonder that all such preparations are everywhere neglected, and coales sold at so low a price that if Smiths could be so easily without coales in forging and working their Metals as Physitians are in preparing their Medicines, certainly colliers would long since have been brought to extreme want. In the mean time I will give to Spagiricall Physitians (chemical physicians) their due praise. For they are not given to idleness and sloth, nor goe in a proud habit, or plush and velvet garments, often showing their rings upon their fingers, or wearing swords with silver hilts by their sides, or fine and gay gloves upon their hands, but diligently follow their labours, sweating whole nights and dayes by their furnaces.

These doe not spend their time abroad for recreation, but take delight in their laboratory. They wear Leather garments with a pouch and Apron wherewith they wipe their hands. They put their fingers amongs coales, into clay and dung, not into gold rings. They are sooty and black, like Smiths and Colliers, and do not pride themselves with cleane and beautiful faces. They are not talkative when they come to the sick, neither doe they extoll their medicines: seeing they well knew that the Artificer must not commend his work, but the work the Artificer, and that the sick cannot bee cured with fine words."

(From Paracelsus, "*Of the Nature of Things*" printed in London in 1650, 4to.)

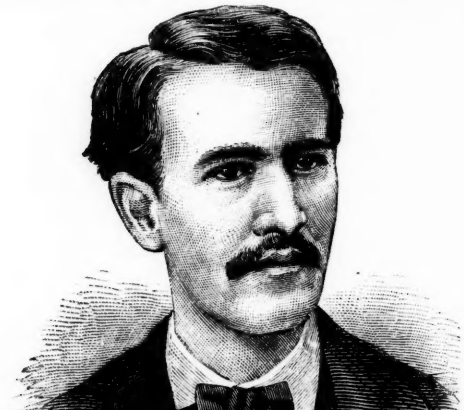
Paracelsus used to claim knowledge of medicines derived direct from God, and once said: "If God does not aid me the devil will help me." His fanatical self-conceit is exemplified in a remark comparing himself with the great reformer, Luther: "Luther is not worthy of untying the strings of my shoes!"

These are but glimpses of his vainglorious, arrogant and bombastic character, in spite of which his lectures were for a time very successful. After a few years, however, his hearers grew weary of his audacious assumptions and disgusted with the low life he led, for habits of intoxication increased and he became a wretched drunkard.

Resigning his professorship he began traveling again and joined by a number of boon companions he passed his time in drinking and carousing. After four years of dissipation, to use the quaint words of Boerhaave "he died as he lived, in a tavern, at Saltzburg, at the sign of the White Horse, on a bench in the chimney corner." This was in 1541, in the 47th year of his age.

In his life time, Paracelsus published only a few books, but after his death a large number were printed in his name. His genuine writings are infected with the arrogant pretensions characteristic of his life.

And yet this "great, anomalous, unaccountable fellow" as "Boerhaave calls him deserves much honor for having introduced chemical preparations into materia medica, making a knowledge of chemistry indispensable to all physicians. He mentions zinc and bismuth as metals, he was acquainted with the virtues of opium, and introduced mercury in specific diseases. He seems to have been a skillful surgeon and to have excelled in the preparation of drugs, a labor which occupied, as a contemporary tells us, "all his sober hours."



EDISON AND THE PHONOGRAPH.

We compile from the *Phrenological Journal*, to which we are also indebted for the excellent accompanying portrait, the following account of Edison and his wonderful inventions.

Thomas Alva Edison was born in Milan, Erie County, Ohio, on the 11th of February, 1847, and is, therefore, scarcely thirty-one years of age. He was a newsboy at eight; and, at the age of twelve, obtained an exclusive contract for the sale of newspapers on the Detroit division of the Grand Trunk Railway. Here his energy and determination to excel began to exhibit itself. He employed several boys to aid him, and continued to travel and sell newspapers until seventeen years of age. Meanwhile, he purchased a small printing outfit, which he carried on the train, and with which he printed a small weekly paper, called the *Grand Trunk Herald.* In this office he was editor, manager, typo, devil, and all, within himself.

Edison soon became absorbed with the telegraph, and speedily very proficient as an operator. He took charge of the telegraph office at Port Huron, but soon quitting the railway telegraph service for the higher branch of commercial telegraphy, we find him occuping positions successively at Indianapolis, Cincinnati, Louisville, Memphis and Boston. While at Cincinnati, in 1867, he conceived the idea of transmitting two messages over one wire at the same time; this had been attempted by electricians many years before, but of this fact Edison was totally ignorant, and he continued to make experiments in every branch of telegraphy, attending to his office duties at night, and experimenting in the daytime.

In 1869 he left the operator's chair entirely, and came from Boston to New

York with a duplex and printing telegraph, the latter being the basis of nearly all the Gold and Stock Exchange reporting telegraph instruments. In New York he soon formed an alliance with electricians and manufacturers, and after years of varied experience with partners in the laboratory and in the shop, has finally and firmly established himself upon an independent footing in an extensive way at Menlo Park, New Jersey, where he is surrounded with everything which can contribute to domestic comfort or facilitate future invention and research. His property consists of a well-constructed and furnished laboratory with chemicals telegraph instruments of every description, etc., etc., in its comprehensiveness being second to no other establishment of the kind in the United States, having a factory with steam power for the construction of models; a foundry for casting iron and brass; a handsome villa, with stables and outbuildings, and comfortable cottages for his assistants and workmen. Among Mr. Edison's contributions to the telegraphic art, we find sixty patents and caveats assigned to the Gold and Stock Telegraph Company of New York, fifty to the Automatic Telegraph Company, and some thirty patents and numerous caveats for miscellaneous inventions; in all a total of one hundred and thirty-nine patents and sixty-seven caveats, and all taken out since 1870. He is joint inventor with E. A. Callahan, of the American District Telegraph instruments (the modern messenger service); inventor of the Domestic Telegraph system (another messenger service); inventor of the main features in the Gold and Stock reporting telegraph; inventor of the American automatic (chemical recording) system; inventor of a chemical recording automatic Roman letter printing telegraph; inventor of the celebrated quadruplex system now so extensively used by the Western Union Company; inventor of numerous forms of duplex telegraphy, and inventor of the Electric pen, which is fast becoming popular as a substitute for circular printing. Other inventions of more or less value, which it would occupy volumes to describe, are the product of Mr. Edison's genius.

The electro-motograph, for which he received the eighth patent issued by the United States for original discovery, would, of itself, give us a perfect system of telegraphy, were magnetism never discovered. It in fact offers the only other means of contributing motion (and controlling it) to mechanism at a distant point —the foundation principle of the electric telegraph.

This is regarded as Mr. Edison's greatest achievement, and one destined some day to prove of immense value. Its extraordinary delicacy may be appreciated when it is stated that in the course of one experiment it was made to give telegraphic signals through 70,000 *ohms* resistance by means of a battery current that through that resistance would not record a trace of itself upon paper steeped in a saturated solution of iodide of potassium.

The electro-motograph telephone is an invention based upon the above described principle of action, and is now demonstrating the marvelous range of action of this wonderful discovery, by transmitting the full compass of vocal and instrumental vibrations over an ordinary telegraph wire 200 miles in length, reproducing the tones with great accuracy.

Mr. Edison has also just perfected a speaking telephone, which reproduces the human voice over great lengths of line with marvelous accuracy and distinctness, by means of which conversation is carried on with great facility. Reiss, a German, Mr. Edison, and A. Graham Bell are the only persons who have ever grappled with this problem. Reiss, in 1866, succeeded in transmitting musical tones and some spoken words. Edison and Bell began experimenting in this direction about the same time, and each has succeeded in producing that which is characteristic of them. Bell's apparatus is the beautiful realization of a theory, but too receptive to outside or foreign electrical influences to be effective in their vicinity, and it is just there, in large cities netted with electric circuits, that the telephone is of value. Edison, using the regular battery, has a direct force commensurate with the work to be done and the foreign influences to be overcome, and can thereby give the volume of sound, and obtain the freedom from confusing effects, which brings effectiveness and marks his telephone with the practical stamp of all his inventions. Mr. Edison is also perfecting an automatic translator, which, when adopted, will prove of great value toward cheapening telegraphy. It will enable one operator to do the work now done by two. He is also engaged in perfecting a sextuplex by means of which six messages may be simultaneously transmitted over a single wire; and lastly, he has finished a machine for recording the human voice and reproducing it at any future time, by which we shall all be able to speak after we are dead.

The *North American Review* for May–June contains an elaborate article from Mr. Edison hmiself, upon "The Phonograph and its Future," from which we make the following extracts:

"The stage of the development reached by the several essential features of the phonograph demonstrates the following as *faits accomplis:*

1. The captivity of all manner of sound-waves heretofore designated as "fugitive," and their permanent retention.

2. Their reproduction with all their original characteristics at will, without the presence or consent of the original source, and after the lapse of any period of the time.

3. The transmission of such captive sounds through the ordinary channels of commercial intercourse and trade in material form, for purposes of communication or as merchantable goods.

4. Indefinite multiplication and preservation of such sounds, without regard to the existence or non-existence of the original source.

5. The captivation of sounds, with or without the knowledge or consent of the source of their origin.

The probable application of these properties of the phonograph and the various branches of commercial and scientific industry presently indicated will require the exercise of more or less mechanical ingenuity. Conceding that the apparatus is practically perfected in so far as the faithful reproduction of sound is concerned, many of the following applications will be made the moment the new form of apparatus, which the writer is now about completing, is finished. These

then, might be classed as actualities; but they so closely trench upon other applications which will immediately follow, that it is impossible to separate them: hence they are all enumerated under the head of probabilities, and each specially considered. Among the more important may be mentioned: Letter-writing, and other forms of dictation, books, education, reading, music, family record; and such electrotype applications as books, musical-boxes, toys, clocks, advertising and signaling apparatus, speeches, etc., etc. * * * * * *

Lastly, and in quite another direction, the phonograph will *perfect the telephone*, and revolutionize present *systems of telegraphy*. That useful invention is now restricted in its field of operation by reason of the fact that it is a means of communication which leaves no record of its transactions, thus restricting its use to simple coversational chit-chat, and such unimportant details of business as are not considered of sufficient importance to record Were this different, and our telephone-conversation automatically recorded, we should find the reverse of the present status of the telephone. It would be expressly resorted to *as* a means of perfect record. In writing our agreements we incorporate in the writing the summing up of our understanding—using entirely new and different phraseology from that which we used to express our understanding of the transaction in its discussion, and not unfrequently thus begetting perfectly innocent causes of misunderstanding. Now, if the telephone, with the phonograph to record its sayings, were used in the preliminary discussion, we would not only have the full and correct text, but every word of the whole matter capable of throwing light upon the subject. Thus it would seem clear that the men would find it more advantageous to actually separate a half-mile or so in order to discuss important business matters, than to discuss them verbally, and then make an awkward attempt to clothe their understanding in a new language. The logic which applies to transactions between two individuals in the same office, applies with the greater force to two at a distance who must discuss the matter between them by the telegraph or mail. And this latter case, in turn, is reënforced by the demands of an economy of time and money at every mile of increase of distance between them."

BOOK REVIEWS.

FIFTH ANNUAL REPORT OF THE STATE BOARD OF AGRICULTURE, of the State of Kansas, for the year ending November 30, 1876. Topeka, Kansas, Geo. W. Martin, Kansas Publishing House, 1877.

We have before had occasion to commend the wisdom of the State Board of Agriculture of Kansas in publishing complete monthly and annual reports of the condition and progress of the agricultural and horticultural interests in that State, instead of expending a much larger amount on an annual fair which would be of insignificant service compared with the substantial and permanent benefit derived from the admirably prepared reports, issued by the able secretary, Mr. Alfred Gray.

The present volume, comprising the Agricultural Report proper, that of the Academy of Science and that of the Centennial managers covers some 650 pages, and is undoubtedly the most interesting and valuable that has yet been published.

One of the most notable features of the Report is the publication of a map of every county in the State, each occupying a full page, and showing Government, Railroad, Agricultural College, and unsold lands, water courses, railroads, location of the school houses, township boundaries, &c., with a chapter correcting all of these points to the date of publication. Twenty-five pages are devoted to tabulated crop reports, one hundred and ten to a statement of industries by counties, and the remainder to meteorological, county, agricultural society, financial and other useful reports, which will be of the greatest service to the immigrant in making up his mind where to settle.

The whole work reflects credit upon the Board and its efficient and indefatigable secretary, whose health, we are sorry to learn, is seriously impaired. The mechanical work is well executed, making it an unusually presentable public document.

CANOEING IN KANUCKIA, or HAPS AND MISHAPS AFLOAT AND ASHORE. By C. L. Norton and John Habberton. Illustrated. New York, G. P. Putnam's Sons, 1878. For sale by Matt. Foster & Co. $1.50.

This is a very interesting description of a summer canoe voyage down one of the tributaries of the St. Lawrence, by several literary gentlemen, with all the concomitants of hunting, fishings, upsets and misadventures necessary to make it attractive and piquant, combined also with a considerable amount of information upon the canoe building and sailing question. No one who commences to read this book will lay it down before he reads it through, and many a canoeing expedition will probably be the result during the coming summer. It is written in a very sprightly manner and cannot fail to handsomely repay its publishers, who have put it forth in a novel and attractive form.

FREE SHIPS. The Restoration of the American Carrying Trade, by John Codman. New York, Putnam's Sons, 1878. For sale by Matt. Foster & Co. 25c.

This is the sixth of a series of essays or economic monographs, by representative writers on subjects connected with trade, finance and political economy.

In the monogram before us Captain Codman argues that the principal thing necessary for us to do in order to regain our carrying trade to foreign countries, is to cease protecting the American ship building industry, especially in steam vessels of iron, and buy our iron steamers of England, where they can be built so much more cheaply and better, thus putting ourselves on an equality with all the maritime nations of the earth except China.

The whole argument applies to a high protective tariff, and is worthy of full and careful consideration by our law makers.

MICROMETRICAL MEASUREMENTS OF DOUBLE STARS. 1877. Published by the Cincinnati Observatory, by Ormond Stone, Director.

It was discovered soon after the invention of the telescope that many stars that seem to the naked eye single, are in reality double. Dr. Hooke is credited by most astronomers with being the discoverer of the first double star. At first it was supposed that the duplicity of such stars arises from the accidental position of

two stars nearly on the same visual line, but an inquiry by Sir Wm. Herschel into a subject of great interest connected with another branch of astronomy, led to the recognition of the fact that most of the double stars are really pairs of physically associated bodies. He found to his surprise that in many instances the smaller of the double stars revolved around the larger, making in fact a system. This has been confirmed by later observations, and within a comparatively short time much attention has been directed to this subject of double stars and their micrometrical measurements. Sir John Herschel, Sir James South, William Struve of Prussia, Argelander, Mitchell, and still later Burnham of Chicago, Howe, Upton, and Stone of Cincinnati and other noted astononomers have devoted much time to this interesting study. The present report gives a list of 930 observed and measured by the last named three gentlemen.

WASHINGTON COUNTY, OHIO, and the Early Settlement of Ohio, by Israel Ward Andrews, LL. D., President of Marietta College. For sale by Wm. Holden, Marietta, O. 40c.

This is the Centennial historical address prepared in accordance with the recommendations of the Centennial authorities of Philadelphia, and is most admirably written and arranged. Very few men in Ohio are as well calculated as President Andrews to do such a work, and to those interested in the early history and progress of that State, as well as of Washington county, it will prove most valuable and intensely interesting.

ELEVENTH SESSION OF THE PRESS ASSOCIATION OF MISSOURI. Compiled by Chas. E. Hasbrook, late Secretary. Ramsey, Millett & Hudson, Kansas City, 1878.

This is a synopsis of the proceedings of the convention of Missouri editors last year at Fredericktown, with the orations, essays and poems produced in full, including that of the late Senator Bogy, which was read by Hon. B. B. Cahoon. The work of compiling has been very thoroughly done by Mr. Hasbrook, who is now one of the vice-presidents of the Association, and the mechanical work is exceedingly tasteful and attractive.

EDITORIAL NOTES.

The *Western Homestead* for May 1878, quarto 34 pps., $2.00 per annum monthly, was received too late for notice.

PROF. T. GAILLARD THOMAS, M. D., in the *New York Medical Monthly* for May proposes the injection of fresh milk into the veins as a substitute for the transfusion of blood in cases of sudden loss or gradual depreciation of the vital fluid; arguing that fresh milk and the chyle which is constantly mixed with the blood and is utilized for nutrition, are similar and closely allied to each other, besides, that the injection of milk into the veins is infinitely easier than the transfusion of blood.

PROFESSOR NIPHER of St. Louis, and Professor Snow, of the Kansas University, are devoting close attention to meteorological observations in their respective States. Indeed such observations are becoming systematized all over the country and must result in a comprehension of natural phenomena far superior to anything hitherto enjoyed by meteorologists.

WE are indebted for complimentary mention of the REVIEW to the veteran Botanist, Prof. Leo Lesquereux, of Columbus, Ohio; Captain H. W. Howgate, of the United States Signal Corps; Prof. Spencer F. Baird, of the Smithsonian Institute; Prof. F. H. Snow, of the Kansas University; Prof. Osborn, of the State Normal School at Warrensburg, Missouri, and to many other friends, both professional and editorial, in different portions of the country.

As an evidence of the growing importance and value of the REVIEW among scientific men we may be permitted to state that we have since our last issue received original communications from New Haven, Ct., Rhode Island, Washington, D. C., Colorado, Iowa, Kansas and Missouri, besides those of the members of our own Academy of Science that appear in this number.

PROF. C. W. IRISH, of Iowa City, kindly sent us an article on the Transit of Mercury, but as we had one already in print which covered substantially the same points, we reluctantly omitted it.

THE Editorial Convention of Missouri meets at Springfield on the 21st day of May, and it is expected that it will be the largest and most interesting meeting of the kind ever held in the State.

THE explosion of the flouring mills, of Minneapolis, on the 2d of May, resulting in the total destruction of the Washburn Mill, the largest on this continent, and several others, with the loss of nearly twenty lives, was attributed to the ignition of gas generated in some unknown manner by the middlings purifiers. To us this seems an absurd as well as an unnecessary theory. If the real cause is ever ascertained we have no doubt that it will be found to have been the sudden ignition of the immense amount of flour atoms floating in the air, just as such explosions have been caused in other mills on a smaller scale, in coal mines where the atmosphere was filled with floating atoms of inflammable coal-dust, and as we believe, in the candy factory blown up lately in New York City.

PROF. PATRICK, of the State University of Kansas, has recently discovered within three hundred miles of this city great quantities of Phosphate of Lime. It will not be needed much in Kansas or Missouri for many years, but as an article of commerce its value is inestimable.

THE *Scientific American* of April 20th gives an illustrated account of the sailing car devised by Mr. C. J. Bascom, of the Kansas Pacific Railway. As this car has been in use several years, it is no novelty in this portion of the West, but doubtless the description will excite considerable interest among our eastern friends.

More than twenty years ago "wind wagons" were tested on the prairies of Kansas, and considerable rates of speed attained; but it was found that owing to friction and uneven surfaces it was impracticable to transport large enough loads of freight to make their use any object to the plains-man, and they were abandoned.

THE Kansas State Academy of Science will hold its semi-annual meeting in this city, June 6th and 7th. A very numerously attended and interesting meeting may be expected.

THE telegraph poles in Java are formed of the trunk of a tree called the "Kapas," which possesses the advantages of taking root and sending forth branches when set into the ground, thus defying the white ants which would rapidly destroy a dead trunk, and of sending forth their branches in a horizontal direction, so that they not only do not interfere with the wires and insulators, but are handsome and of course durable.

THE detection in water of gelatine is of serious moment as affecting its purity as a wholesome drink. The test solution used by Kaemmerer consists of 2 parts of tannin, 1 part of sugar, 3 parts of water, and 5 of alcohol, and when gelatine is present it causes a flocculent deposit. The presence of this substance is due to the development of certain forms of microscopic vegetation, the decomposition of which causes a very dangerous impurity when in sufficient quantity.

THOMAS HELLAR, of Sedgwick county, Kansas, has discovered a valuable bed of peat upon his farm. He says the deposit is from four to fifteen inches thick and entirely free from sand and dirt, and that the lower half of the bed is extremely compact. He estimates that in that single bed there is fuel enough to supply the neighborhood for fifteen years. The bed lies between a precipitous bluff and the bank of the creek, in a half circle containing several acres. From the foot of the bluff a spring of water, a large volume of which pours out as thick as a man's arm, is situated. Underneath the bed of peat is clear sand. He thinks other equally valuable deposits will be discovered. It burns perfectly leaving only a small residue of white ashes. His sons are mining or taking it out and stacking it up to dry, having put in a thorough drain.

DR. SHŒPNER, of Berlin, recently delivered a lecture at Berlin, which has been translated by Madame Blavatsky and published in the Supplement of the *Scientific American*, to prove that our globe neither rotates upon its axis nor around the sun. Almost simultaneously "Brudder Jasper" of the African Methodist Episcopal church delivered a discourse in which he undertook to prove that the earth is square and the sun moves around it.

THE May-June number of the *North American Review* contains the following articles: "Is the Republican Party in Its Death Struggle?" by Senator T. O. Howe; "The Sovereignty of Ethics," by Ralph Waldo Emerson; "Our Commerce with France," by J. S. Moor; "Discipline in American Colleges," by James McCosh, President of Princeton College; "The Army of the United States," by Gen. James A. Garfield; "Is Man a Depraved Creature?" a debate, by Rev. T. W. Chambers, D. D., and Rev. O. B. Frothingham; "The Irrepressible Conflict Undecided," by Senator A. Cameron; "Chinese Immigration," by M. J. Dee; "The Phonograph and its Future," by Thomas A. Edison, the inventor of the instrument; Contemporary Literature. Published at 551 Broadway, New York, and for sale by booksellers generally.

A NEW edition of Prof. Jordan's "Manual of the Vertebrates of the United States" is in progress. It will be enlarged by the addition of nearly one hundred pages, and in it the nomenclature will be brought fully to date of publication, and all the lately discovered species made known by our active band of ornithologists are included. The fishes are entirely re-written; all the genera are fully and *exactly* characterized, many of them for the first time, and the names used are those adopted by the Smithsonian Institution, the U. S. Fish Commission and by the Government Surveys. Natural diagnoses have been in the fishes everywhere substituted for the artificial keys, the application of which is often unsatisfactory and uncertain.

An addenda includes descriptions of all American species of Salmon and Trout, embodying results of the latest researches conducted by Professors Gill and Jordan, under the auspices of the U. S. Fish Commission. Previous to this no person living knew anywhere near how many species we had in America, what the boundaries of these species were, or what name any of them ought to bear. This feature of the book ought to commend it to anglers.

A list of the works on American Vertebrates, which has been found most useful to the writer, is included, which students wishtng to begin original work will find a valuable guide to the scattered literature of the subject.

A glossary of specific names used for our Vertebrates is a novel feature, which will be appreciated by all students who wish to know what the scientific names mean and why they are applied.

The work has the hearty approval of Prof. Baird, Prof. Cope, Dr. Coues, Dr. Gill, Prof. Allen, Mr. Henshaw. Prof. Ridgeway, Prof. Forbes, Dr. Wilder, Prof. Goode, Dr, Yarrow, Prof. Milner, and of the best students of American Vertebrates generally. It will be published immediately by Jansen, McClurg & Co., Chicago.

XUM

PROF. NIPHER, Director of the Missouri Weather Service, publishes with his Report for April 1878 a complete set of observations of the rainfall in St. Louis by months from 1839 to 1877 inclusive, made and recorded by the veteran observer Dr. Englemann of that city, by which, among other things, it appears that in 1858 the greatest amount of rain (68.83 inches) fell, and in 1871 the smallest amount, (21.87 inches.) Also that in Nov. 1876 the greatest amount fell for any one month, viz. 11.55 inches, and in November 1865 the smallest, 0.00 inches.

THE percentage of verifications of the U. S. Signal Service predictions for March 1878 were as follows: 87.0 for New England; 88.8 for the Middle States; 87.6 for the South Atlantic States; 79.5 for the Eastern Gulf States; 81.7 for the Western Gulf States; 87.4 for Tennessee and the Ohio Valley; 87.2 for the Lower Lake Region; 87.4 for the Upper Lake Region; 86.6 for the Upper Mississippi Valley, and 84.6 for the Lower Mississippi Valley. By elements the percentage verified averages 88.8 for the weather; 85.6 for the direction of the wind; 87.6 for the temperature, and 81.8 for the barometer, all of which is pretty good guessing for "Old Probs."

WE regret very much the article on the "New Mounds" discovered near Warrensburg was received too late to have the drawings which accompanied it engraved. Several of them were very remarkable representations, and were skillfully executed by the writer.

VOLUME II, Part I, Proceedings of the Davenport Academy of Natural Sciences was received from Mr. Putnam, the corresponding secretary, too late for notice in this number of the REVIEW. It is a handsome volume of 148 pages octavo, illustrated. Price $1.50.

THE silver mines of Woodson county, Kansas, are attracting considerable attention at present. The Silver City Mining Company have struck a lead in their shaft at thirty feet, containing silver, dipping to the north at an angle of forty-five degrees; they passed through it and are down forty-two feet and intend to go down sixty feet, and then tunnel to the vein.

Dewald & Co. are down forty feet, but have come up in their shaft to about twenty-eight feet, and are tunneling. They are taking out ore said to contain silver and copper.

THE Kansas State University holds its annual commencement exercises on May 27th, 28th, 29th and 30th. Gen. C. W. Blair, of Fort Scott, has been chosen to deliver the oration. Usually the commencement exercises are very attractive and interesting, and we presume this year will prove no exception to the rule.

AN excellent opportunity for the observation of the phenomena attendant upon full solar eclipses will be furnished in the United States by the eclipse of the 29th of July next, as this will be total in the western part of North America and in the island of Cuba. The longest duration of totality will be in the southeastern part of British Columbia; and in the states on the western slopes of the Rocky Mountains, in parts of which the time of totality will exceed three minutes. It is suggested that at or near Denver will be the best place of all for the observation, as it is very easily reached, and the sun's altitude at the time of the eclipse will be quite considerable.

THE closing exercises of Missouri University, for 1878, will take place as follows: May 27th, to June 5th, Wednesday, public examinations. June 2d, Sunday, Baccalaureate Sermon, by Rev. David R. McAnally, D. D., of St. Louis. June 3d, Monday evening, Address to the Medical School, by Prof. P. Gervais Robinson, M. D., of St. Louis; also valedictory of the class and delivery of diplomas. June 4th, Tuesday evening, annual oration before the literary societies, by Col. John F. Phillips, of Sedalia. June 5th, Wednesday evening, oration before the Alumni Association, by Joseph V. C. Karnes, of Kansas City.